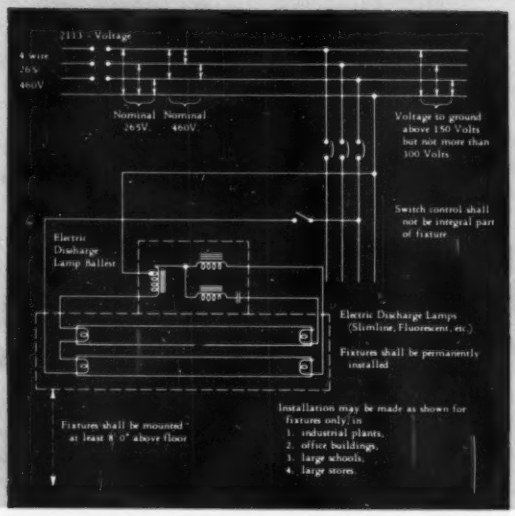
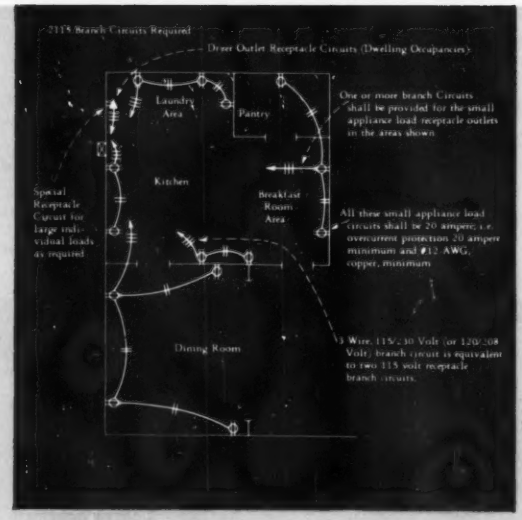
SEPTEMBER 1953
PRICE 35 CENTS

ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING


Nominal 265V.
Nominal 460V.
Voltage to ground above 150 Volts but not more than 300 Volts
Switch control shall not be integral part of fixture
Electric Discharge Lamp Ballast
Electric Discharge Lamps (Slimline, Fluorescent, etc.)
Fixtures shall be permanently installed
Fixtures shall be mounted at least 8' 0" above floor
Installation may be made as shown for fixtures only in
1. industrial plants,
2. office buildings,
3. large schools,
4. large stores.

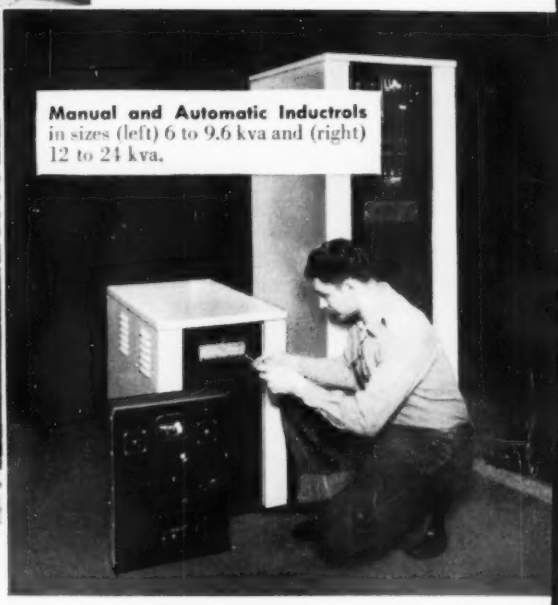

Dryer Outlet Receptacle Circuits (Dwelling Occupancies)
Laundry Area
Pantry
Kitchen
Breakfast Room Area
Dining Room
One or more branch Circuits shall be provided for the small appliance load receptacle outlets in the areas shown
All these small appliance load circuits shall be 20 ampere, i.e. overcurrent protection 20 ampere minimum and #12 AWG copper, minimum

Special Editorial Report

1953 Revisions of the National Electrical Code, an analysis and discussion of important new code changes by B. A. McDonald, illustrated by B. Z. Segall. Complete in this issue.

A McGRAW-HILL PUBLICATION | 52ND YEAR

FLUORESCENT LAMPS need constant voltage for maximum operating efficiency and lamp life.



Manual and Automatic Inductrols in sizes (left) 6 to 9.6 kva and (right) 12 to 24 kva.

Maximum equipment life—less operating cost with G-E voltage regulators

You can eliminate the harmful effects of undervoltage and overvoltage on your a-c electric equipment by installing G-E Inductrols. These dry-type regulators automatically maintain correct voltage and insure peak operating efficiency.

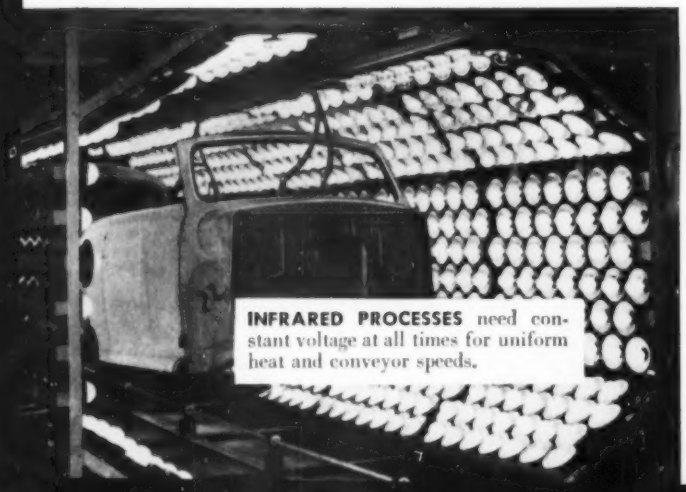
Standard automatic regulators are available for circuits from 3 kva, 120 volts up to 520 kva, 600 volts either single- or three-phase. For more information, contact your nearest G-E Sales Representative, or write for Bulletins GEA-5824, GEC-795 and GET-2351. General Electric Company, Section 423-202, Schenectady 5, New York.

You can put your confidence in—

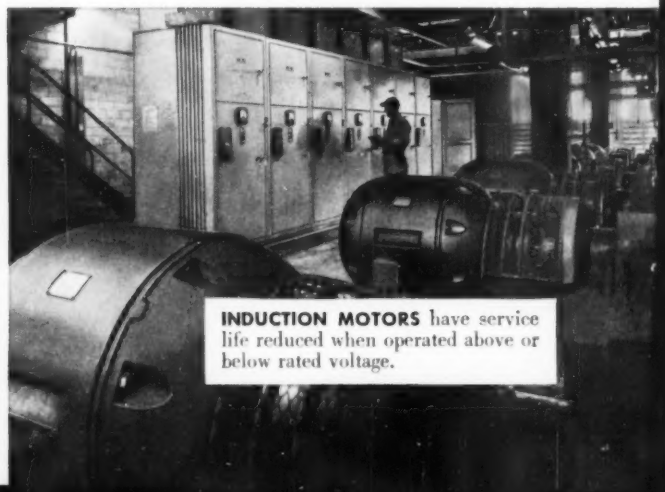
GENERAL ELECTRIC

WHY YOU NEED GOOD VOLTAGE

EQUIPMENT	10% UNDERVOLTAGE	10% OVERVOLTAGE
INCANDESCENT LAMP BULBS	Cuts light output 30% —slows production	Cuts life 70%—triples costs
A-C MOTORS	Overheat—ups maintenance costs	Lowers power factor —ups power costs
RESISTANCE HEATERS	Cuts heat output 19% —slows production	Overheats—ups replacement costs
ELECTRONIC DEVICES	Probably destroy gas-filled tubes	Only 5% over cuts tube life 50%
INFRARED PROCESSES	Ups process time —slows production	Blisters, scorches—ups production cost

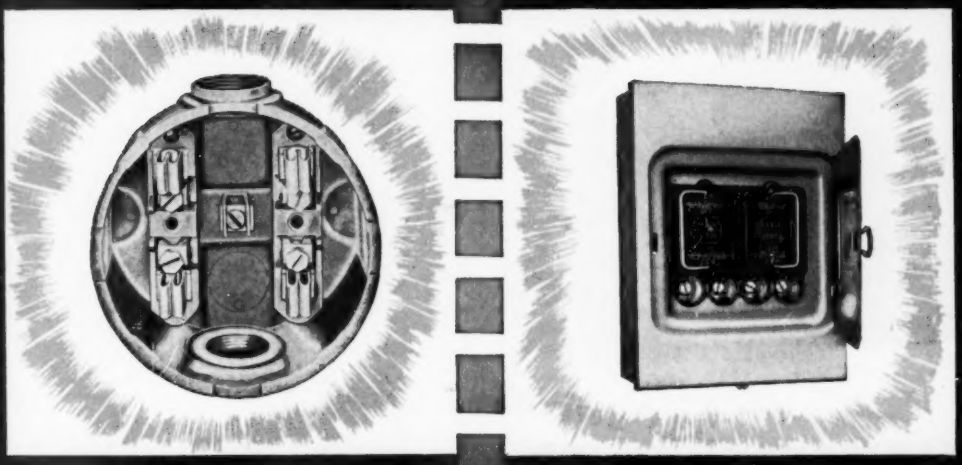


INFRARED PROCESSES need constant voltage at all times for uniform heat and conveyor speeds.



INDUCTION MOTORS have service life reduced when operated above or below rated voltage.

They're Designed to MATCH



And Save you MONEY

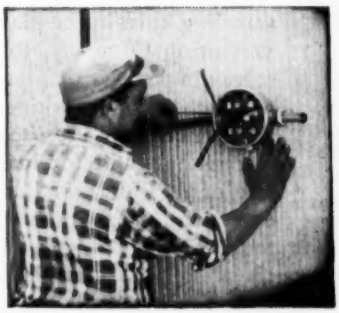
Make the job easier and quicker by using Murray matched equipment. All elements of each unit are designed to go together. Take the Murray Meter Socket and the Murray "Main and Range" illustrated. Installation is easier and quicker because knock-outs are positioned just right. Wiring is simplified because lugs are similar on both units. In addition, once installed, Murray matched equipment looks better and more workmanlike than devices from two different manufacturers.

HERE'S *Proof* THAT Murray MATCHED EQUIPMENT *SAVES MONEY!*

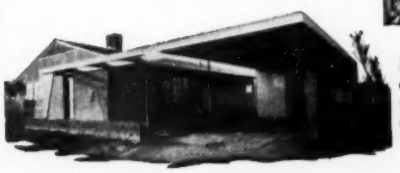
Levittown, Long Island (17,000 homes) is using Murray matched equipment to handle the load. Now, another large project is being developed —16,000 homes at Levittown, Pennsylvania. Murray matched equipment is being used again!

Further proof of the advantages of matched equipment is at Fairless Hills, Pennsylvania — a project of 4000 homes. The Murray Meter Socket and the Murray "Main and Range" are back-to-back on a large percentage of these homes.

It comes down to this — Murray matched equipment saves time in installation — and time is *money*. Whether it's a huge project or a bungalow — matched equipment saves time and money.



Electricians like Murray equipment because it's easy to install. There's always plenty of wiring room in Murray equipment!



One out of the 16,000 modern houses being built at Levittown, Pa. Murray Meter Socket is located on outside wall, rear. Murray "Main and Range," located in a utility closet, backs it up on the inside.

MURRAY MANUFACTURING CORPORATION
1250 Atlantic Avenue, Brooklyn 16, New York

Service Entrance & Meter Equipment • Magnetic Hydraulic Circuit Breakers • Safety Switches (Types A, C & D) • Current Limiting Reactors • Crows'nest Aerial Ladders

A wide open market and profitable sales for you in the industrial field with . . .

trouble-free . . . 335° swivel

APPLETON REELITE

TRADE MARK

Traveling Power Supply

● This Appleton "YS" *Reelite* supplying power to a traveling hoist in the plating department of the Atwood Manufacturing Company, Rockford, Illinois, shows you how to solve the problem . . . quickly and profitably . . . of supplying power to moving machinery. Sell them an APPLETON *Reelite!*

The new "YS" *Reelite* illustrated above is a quality product throughout built for long, continuous service. The complete line of APPLETON *Reelites* includes a style and model for every job . . . from the largest locomotive crane to small hand tools. For added sales and profits for *you* in the industrial traveling power field, you should have our Bulletin 504 . . . write for it today!

SOLD THROUGH ELECTRICAL WHOLESALERS ONLY

- **Feeds and retrieves power cord in any direction (335° swivel) to double track coverage.**
- **Enclosed copper graphite brushes and copper collector rings eliminate dangers of exposed collectors, trolleys, wires.**
- **Neoprene covered cables seal out moisture, oil, chemical fumes.**
- **Easy to maintain since power spring, brushes, etc., may be removed through outer covers. Solderless cord connections . . . oil-less bearings.**
- **A heavy duty hoist reel—Rating: 15 amperes, 550 volts, AC; 250 volts, DC.**

APPLETON ELECTRIC COMPANY
1704 Wellington Avenue • Chicago 13, Illinois

Also Manufacturers of:

Explosion-proof Fixtures

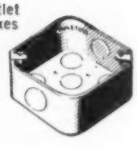
Unilet Fittings

Industrial Lights

APPLETON ELECTRIC PRODUCTS

"ST" Series Connectors

Outlet Boxes



ELECTRICAL CONSTRUCTION AND MAINTENANCE

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GENERAL-PURPOSE CONTROL

Fhp motor starter

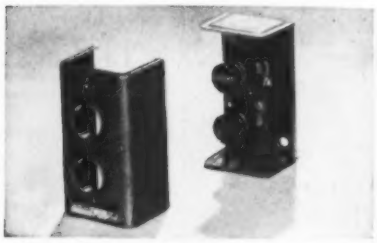
1—7½ hp manual motor starters

A-c magnetic motor starter

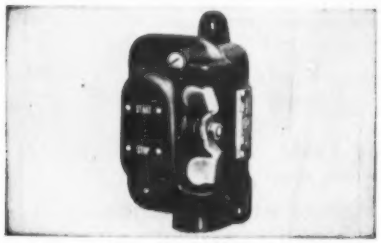
Combination motor starter

Reversing motor starter

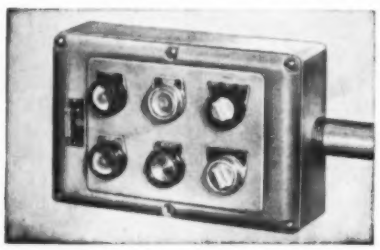
Choose from G.E.'s complete line of push buttons

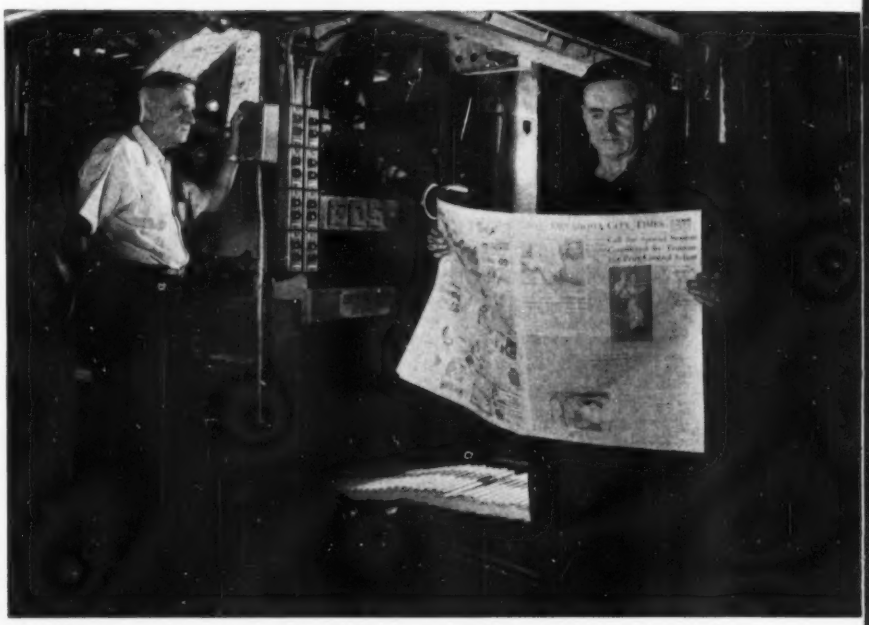

Standard-duty station, cover removed

Heavy-duty, for wall or flush mounting


Standard-duty watertight station

Standard-duty explosion-proof enclosure


Oiltight station mounted horizontally


General Electric push button installation at Oklahoma Publishing Company. Mounted on this newspaper press are eight heavy-duty stations of two units each together with a six unit oiltight station.

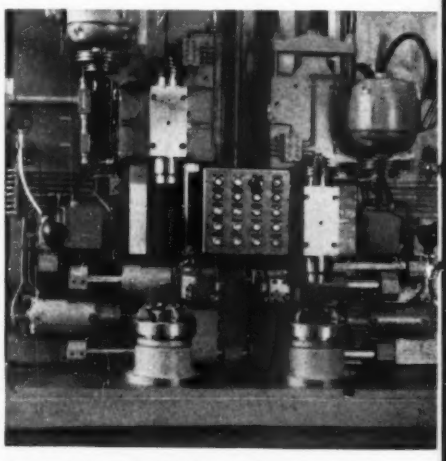
You'll find the right push-button unit or station for your particular application when you select a dependable G-E control accessory. All units have a continuous rating of 10 amps for all voltages.

THREE BASIC TYPES

Standard-duty—for average applications. Enclosures include general-purpose, dust-tight, watertight, and explosion-proof. Over-all rugged construction includes fine-silver double-break contacts which make contact maintenance virtually unnecessary. And wiring is easy—front-connected terminals, ample space speed installation. For further details, write for Bulletin GEA-3469C.

Heavy-duty—designed to withstand the roughest industrial use. Contacts are heavier than in standard-duty forms; enclosures are heavier gage steel. Designed for maximum flexibility to provide for requirements which cannot be accommodated in standard-duty line. Forms are available with selector switches, indicating lights and maintained contact buttons. Forms for palm or foot operation are also available. Bulletin GEA-5043A gives complete details on these stations.

Oiltight—adapted to machine tool service or where oil or coolant is present. All stations meet JIC specifications in every detail. Strong, lightweight, cast aluminum enclosures are designed for convenient wiring. The units install easily and a specially designed washer keeps the units oiltight with normal hand tightening. Bulletin GEA-5779A gives ratings and complete information.


Twenty-unit G-E oiltight station on special hydraulic-actuated duplex machine built by Snyder Tool and Engineering Co., Detroit.

INFORMATION FOR CONTRACTORS-PLANT ELECTRICIANS

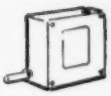
Reduced voltage starter

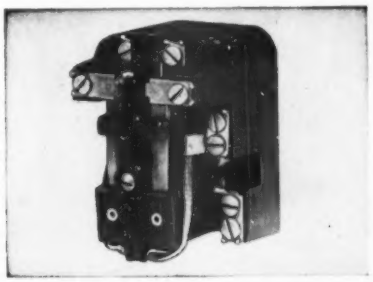
Heavy and standard-duty push-button stations

General-purpose relay

A-c and d-c solenoids

Roller-lever type limit switch

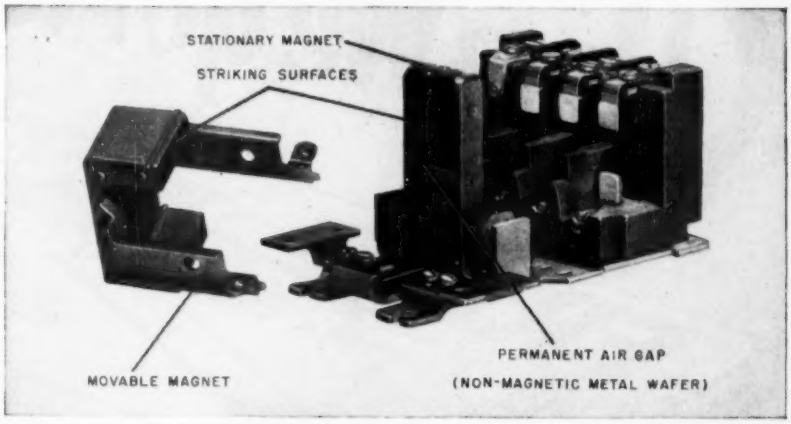

Rotating-type limit switch



NEW GENERAL-PURPOSE RELAY REDESIGNED FOR LONGER LIFE

The new CR2790E relay reduces your inventory—the basic relay and accessories meet a variety of applications. For general control-circuit applications, as a fractional-hp motor starter or, in combination with a magnetic switch, for controlling larger motors. Continuous current rating is 10 amps up to 300 volts on AC or DC. New long-life shunt assures top electrical performance. Bulletin GEC-257C lists available accessories, ratings and dimensions.

G-E MAGNETIC STARTER FEATURES PERMANENT AIR GAP



The G-E starter has a **permanent** air gap, a non-magnetic metal wafer mounted in a stationary magnet structure. Magnets never stick closed because of residual magnetism. The air gap is safely away from striking surfaces so the movable magnet cannot wear it down, no matter how often the starter is operated.

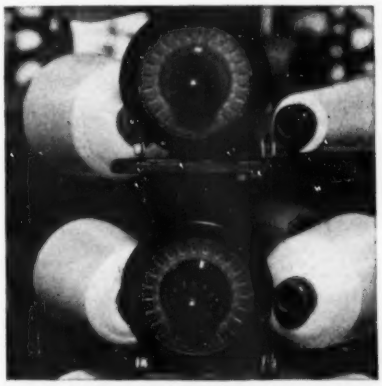
On some starters the air gap disappears as the magnets wear. With a G-E starter, however, you can be sure that every time you push the STOP button the magnet will drop out and stop the motor.

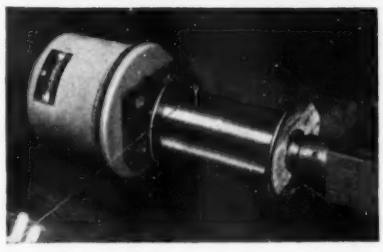
You're assured reduced maintenance, long mechanical life when you specify G-E magnetic starters.

NEW MAGNETIC BRAKE KEEPS TENSION CONSTANT

G.E.'s new tension brake—the first of its kind—is a magnetic device free of the basic disadvantages of friction devices, such as wide tension variations and undue wear. You'll find applications for the new brake wherever a constant tension is required—for yarns, rubber, glass fiber, and small diameter wire. Simple and compact, the brake holds tension constant at all speeds.

The size 200 brake has a torque range from 0.1 to 0.5 oz. in. and a tension range from 4 to 10 grams. Shown at the right in a textile application, the brakes are mounted on a magazine-type warping creel. The larger brakes, sizes 300 and 400, have a torque range of 1.4 to 14 oz. in. over a speed range of 0 to 1500 rpm. Write for Bulletin GEA-5867.





Size 400 tension brake in resistor wire-winding application. Increase or decrease tension by turning easy-to-read, calibrated adjusting cap.

NEW G-E STOCKING PLAN ASSURES PROMPT SHIPMENT

G.E.'s new Prompt Service program assures you faster, better service for your order. The program is based on perpetual stocking in your area, and prompt shipment of widely used general-purpose devices. You pay no premium for this service and you'll need no follow-up on these orders. You can reduce your control inventory. Check coupon for complete information.

General Electric Company
Section A730-46
Schenectady, N. Y.

Please send me the Prompt Service Bulletin listing the general-purpose control devices stocked for immediate delivery in my area.

Name _____

Address _____

For more information contact your nearest G-E representative, agent, or distributor, or write Section A730-46, General Electric Co., Schenectady 5, N. Y.

GENERAL ELECTRIC

Remember that Red Hot 1949 Briegel Combination Indenter and Fitting Deal? It broke all records then so here we go again!

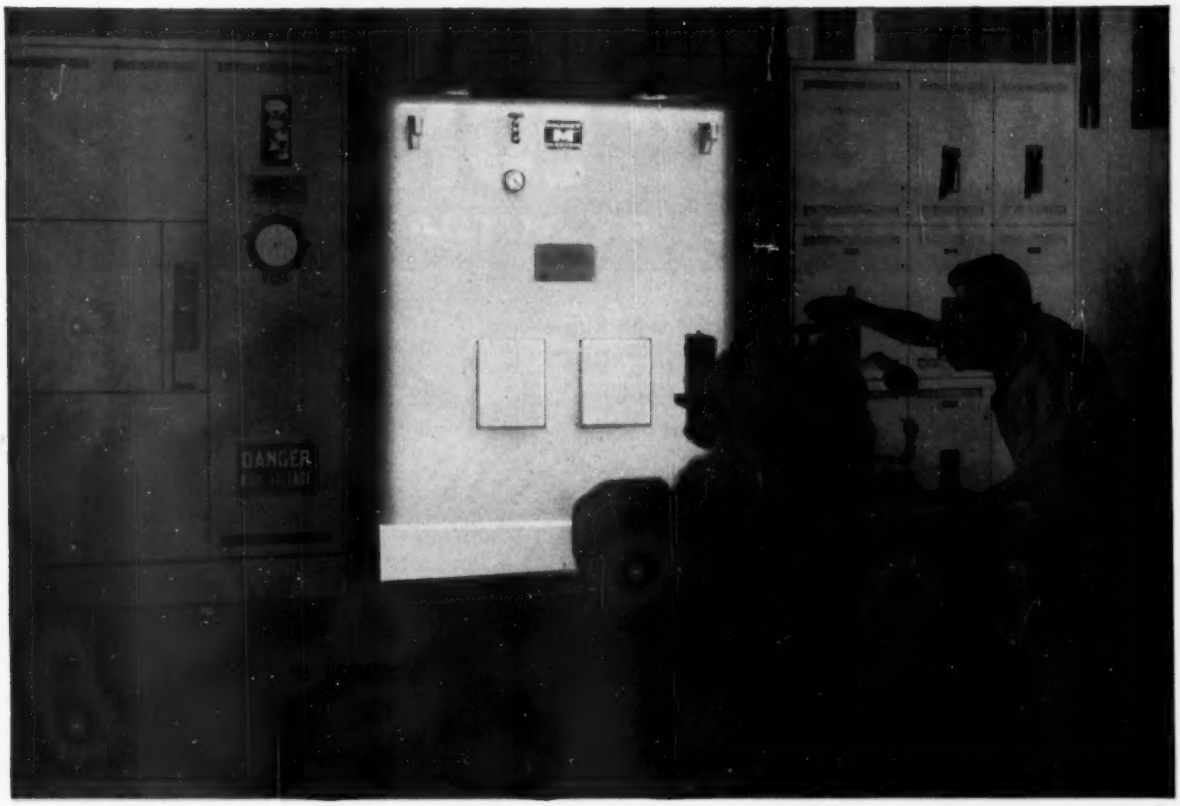
For three months only, August, September and October, a Special Package Offer of 200-½" B. M. Couplings and 400-½" B. M. Connectors. Free of extra cost in this package will be 1 No. 606 Briegel ½" Indenter!

Stock up today with this Deal that sold out the last time it was offered.

BRIEGEL METHOD TOOL CO.

GALVA, • ILLINOIS

WHERE SAFETY IS FIRST



Specify Moloney Class "H" Dry Type Transformers . . .

Safety of men or machines is no problem when you install Moloney Nitrogen sealed Class "H" insulated Dry Type Transformers. For Moloney offers you more in increased protection against fire and explosion hazards. These versatile and dependable transformers can be located indoors or outdoors *right next to the job* and more than meet the most exacting insurance requirements. And this also means important savings in costly copper connections . . . less danger of accidental power interruptions.

Nitrogen filled Class "H" insulated Dry Type Transformers do not produce toxic gases, never need expensive vault installations. Maintenance is easy and the nitrogen atmosphere protects insulation from oxidizing, means longer, more dependable transformer life.

Solve your load center problems the practical way with the modern transformers that go where *you* want them—the Nitrogen sealed Class "H" Dry Type Transformers with the "extra value" that is the mark of Moloney.

MES3-28

MOLONEY ELECTRIC COMPANY

Manufacturers of Power Transformers • Distribution Transformers • Load Ratio Control Transformers • Step Voltage Regulators • Unit Substations

SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES AT ST. LOUIS, MO. AND TORONTO, ONT., CANADA

Fishing is easy with

"XDUCT" CONDUITS

PROVED BEST BY ACTUAL FISH TEST!

Actual fishing tests conducted with five other leading brands of conduit prove "XDUCT" is 66% easier to fish on constant pull—more than *twice* as easy to start as other leading conduits.

Yessir, the *new* National Electric "XDUCT" Conduits fish *easier* than the five other leading brands of conduit on the market today. That's BIG news and we're mighty proud of it.

"XDUCT'S" new baked-on inside coating of aluminum enamel (patent applied for) was developed through intensive research in connection with vital government projects. It provides minimum friction between conduit wall and wires. The result: the easiest fishing ever offered to the electrical industry.

LISTED BY UNDERWRITERS' LABORATORIES, INC. • SOLD BY LEADING ELECTRICAL

"XDUCT" RIGID STEEL THREADED CONDUIT

"XDUCT JR." ELECTRICAL METALLIC TUBING

But that's not all!

THE NEW "XDUCT" CONDUITS PROVIDE:

1. ***Better Corrosion Resistance.*** National Electric's revolutionary new patented electrogalvanizing process deposits electrolytically pure zinc *uniformly* over the entire outside surface of "XDUCT" conduit, *including the threads.* The result: a protective coating that adheres positively to the basic steel . . . possesses superior corrosion resisting qualities.

2. ***Thread Protection.*** Sharp, clean threads of "XDUCT" rigid steel conduit are machined *before* galvanizing to assure complete protection from end to end. The result: every hill and valley of threads are completely galvanized.

3. ***SUPERIOR Bending.*** High-ductile steel is used to assure easy bending.

4. ***Desirable Color.*** "XDUCT'S" silvery color is highly acceptable for installation in exposed locations.

FREE BOOKLET!

WRITE FOR THE FACTS. Send for your copy of this 24 page booklet giving full information on the new "XDUCT" Conduits and the amazing fishing tests described above. *Prove it to yourself!* Use the coupon.

EVERYTHING IN WIRING POINTS TO

National Electric Products

3 Plants • 7 Warehouses • 34 Sales Offices

WHOLESALERS EVERYWHERE

NATIONAL ELECTRIC PRODUCTS CORPORATION
140 Stanwix Street
Gateway Center
Pittsburgh 22, Pennsylvania

☐ Please send me your FREE facts booklet on the new "XDUCT" Conduits.

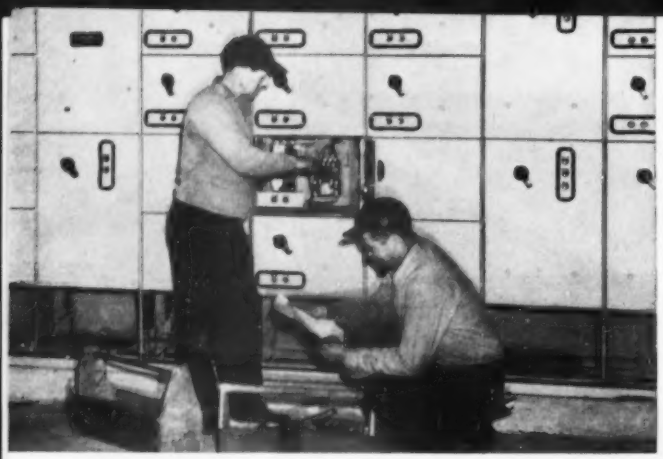
☐ Please have your representative call.

Name_____

Title_____

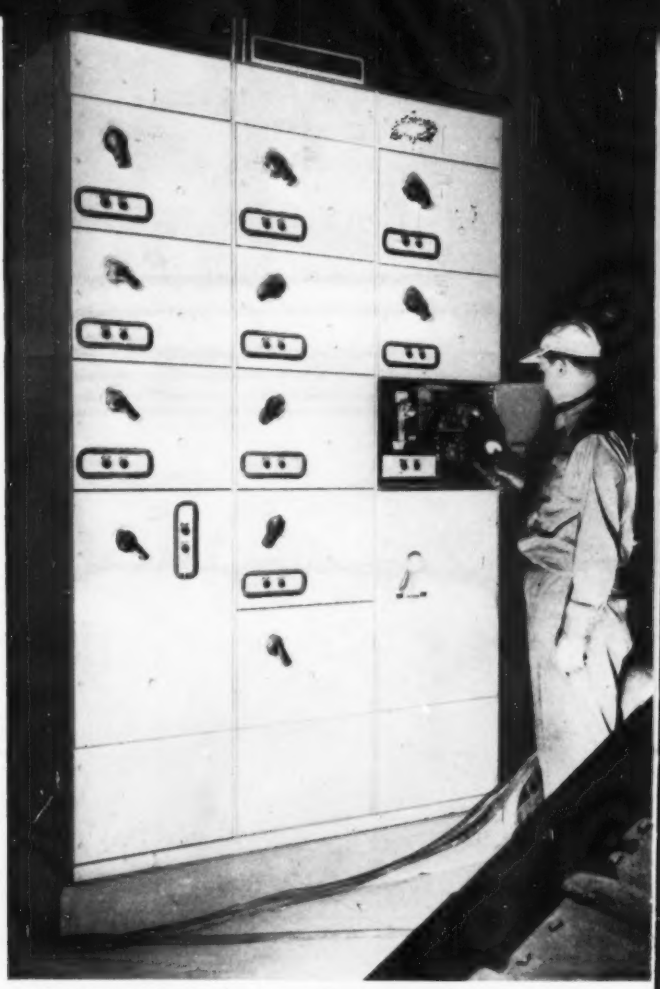
Company_____

Address_____



EASY-TO-INSTALL front-connected units and a large, accessible 13-inch conduit space make wiring fast. Lightweight, compact, strong units with stab-on connectors make handling easy.

A G-E PACKAGED JOB and proven dependability of G-E motor control centers sold the planning team of George Sall Metals Company and Kuljian Corporation engineers on specifying G.E.



STEEL BARRIERS isolate live busses from personnel for maximum safety during inspection and maintenance. Disconnect position allows safer maintenance without shutting down the center.

G-E Motor Control Centers Specified For New "Automatic" Processing Plant

The Kuljian Corporation, Philadelphia, engineers and constructors, specified G-E motor control centers to help in the "automatic" processing of scrap metal at the non-ferrous smelting plant of The George Sall Metals Company in Philadelphia. Like other industries—chemical, paper, automotive—where automatic control is important, George Sall Metals wanted the most modern up-to-date equipment available. They had the plant planned for the ultimate in economical and automatic processing.

Whether you are building a new plant or modernizing existing facilities, specify G-E motor control centers for centralized control of a-c motors up to 200 horsepower.

FOR MORE INFORMATION, contact your nearby General Electric Apparatus Sales Office or authorized distributor, or write Section 781-5 for Bulletin GEA-4979A today. General Electric Company, Schenectady 5, New York.

1878 75 1953 YEARS OF ELECTRICAL PROGRESS

You can put your confidence in—

GENERAL ELECTRIC

FOR OFFSET NIPPLES, NO-THREAD FITTINGS, CONDUIT BODIES . . .

GEDNEY *ALWAYS!*

YOU CAN ALWAYS rely on Gedney Fittings to cut *installed costs* and save real money. For Gedney Fittings are always accurately machined and threaded . . . smooth finished, with no burrs or metal particles . . . quick and easy to install . . . made of unbreakable malleable iron. . . . For best profits, order Gedney Fittings, always!

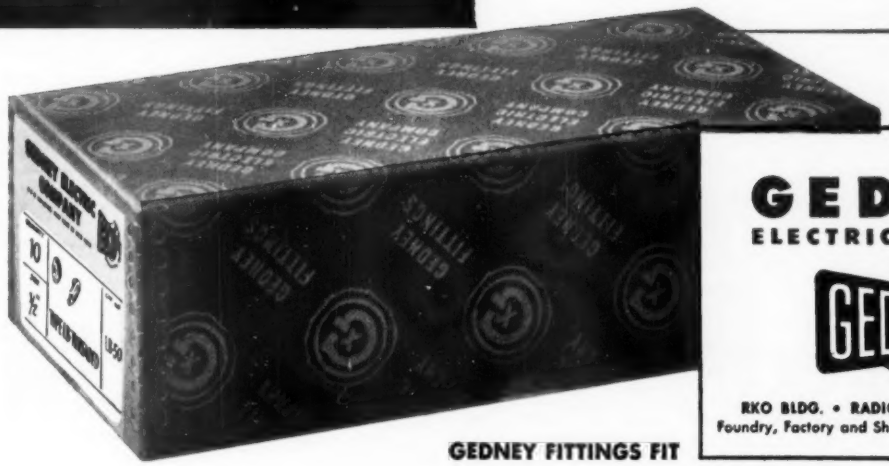
TYPICAL OF THE FULL GEDNEY LINE OF MALLEABLE IRON FITTINGS ARE:

Offset Nipples in sizes from ½" to 2", with ¾" offset. Cadmium plated.

A wide choice of No-Thread 90° Elbows for rigid conduit, and of No-Thread Couplings and Connectors for Sealtite* conduit – all cadmium plated.

*Trade Mark – The American Metal Hose Branch of The American Brass Co.

Conduit Bodies in a full range of types and sizes for heavy wall rigid conduit – hot dip galvanized.



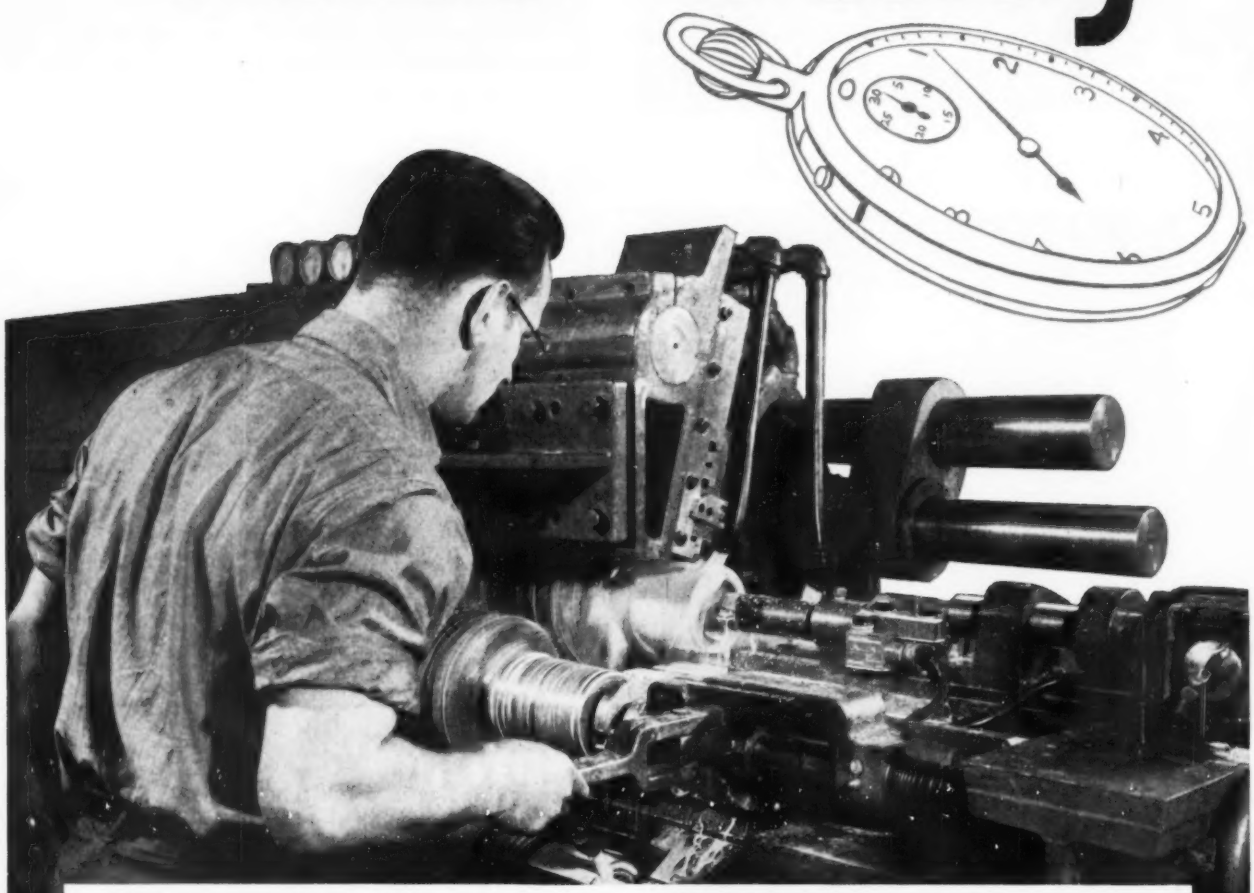
GEDNEY FITTINGS FIT

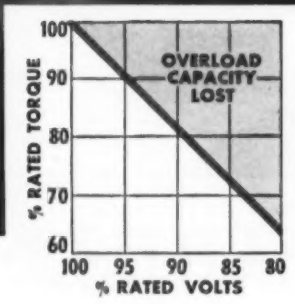
GEDNEY
ELECTRIC COMPANY

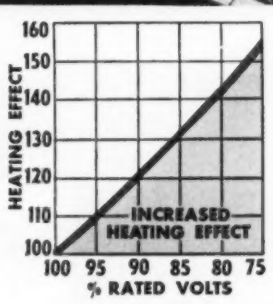
GEDNEY

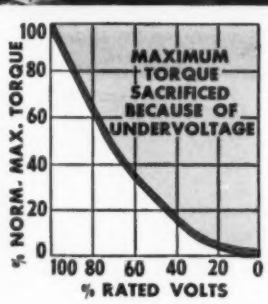
RKO BLDG. • RADIO CITY • NEW YORK 20
Foundry, Factory and Shipping Point: Terryville, Conn.

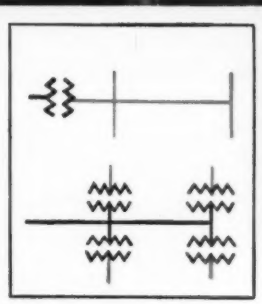
Time-Study











FULL PRODUCTION demands that rated voltage be maintained to all motors. Overload capacity, that extra push necessary for short intervals on many processes, falls off rapidly on undervoltage . . . falls approximately 10% for every 5% drop below rated voltage.

MOTORS BURN OUT quicker at undervoltage because of increased heating effect. Overload relays in the controls protecting your motors trip because of the extra current through them, open circuits to motors — cause machine down-time and production loss.

JOBS TAKE LONGER because torque and horsepower drop when voltage drops. Less torque means lighter cuts on lathes, shapers and other machine tools. More time must be spent to get the same job done. More overhead, more manhours must be figured into every job.

A MAJOR CAUSE of undervoltage is voltage drop in secondary feeders. Existing systems may not be adequate for new production schedules. Install A-C Substations at load centers to reduce line losses, cut feeder length, hold proper voltage, increase production.

Your Voltage

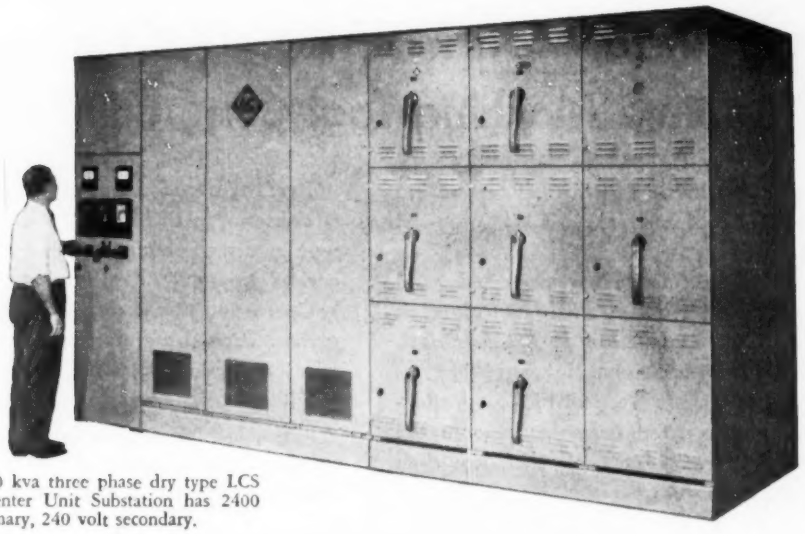
STOP WASTING MANHOURS on slow producing machines. Get the most from the production equipment in your plant by installing unit substations to correct undervoltage. No electrical equipment gives top performance *unless* it operates at rated voltage . . . and even well designed distribution systems may prove inadequate because of today's added loads and increased production schedules.

For example, if your squirrel-cage motors operate at 10% undervoltage, maximum torque available to start machinery is reduced 19% . . . heating effect within the motors is inceased 21% . . . overload capacity falls, efficiency drops.

Increase your output by eliminating production slow-downs resulting from overloaded motors . . . machine down-time due to tripped starters or circuit breakers. Install Allis-Chalmers LCS Unit Substations at load centers and eliminate excessive line drop by shortening low voltage cables. Allis-Chalmers LCS Load Center Unit Substations are neat, compact, easy to install, and provide protection to personnel.

You can count on the cooperation of experienced Allis-Chalmers substation engineers in working out your distribution system. Get in touch with your A-C representative, or write Allis-Chalmers, Milwaukee 1, Wisconsin. Ask for bulletins 11B6285A, 11B6325B and 11B6895. A-3371

ALLIS-CHALMERS
LCS
LOAD CENTER
Unit Substation



This 750 kva three phase dry type LCS Load Center Unit Substation has 2400 volt primary, 240 volt secondary.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

BUS DUCT IS FLEXIBLE

3 men install 755 ft. of BUS DUCT in 4 days at Lapointe Machine Tool Company

Secondary power distribution for a plant expansion was no problem for Lapointe Machine Tool Company, Hudson, Mass.

Westinghouse Plug-in Bus Duct was selected—and installed in record time! Three men using a fork truck completed the 755-ft. installation *in just four days.* The savings paid for an additional lighting job.

The flexibility of plug-ins every foot saved production, too. With power taken temporarily from the duct, they moved 139 machine tools with less than five minutes down time per operator.

Prefabricated in any length up to ten feet, Westinghouse Bus Duct installs easily with sliding-type cantilever hangers. Duct is fully salvageable—can be expanded or relocated readily.

Up to 5000 amperes, Westinghouse Bus Duct has greater current-carrying capacity than any system of wireway, cable or conduit. Four types are available to handle all load conditions and service requirements.

Call your Westinghouse Representative for complete details or write for B-5835, Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Penna.

J-30128

APPARATUS DISTRIBUTOR

YOU CAN BE SURE...IF IT'S Westinghouse

DESIGN TESTED AND VERIFIED in the Westinghouse HIGH POWER LABORATORY

25% More CLAMPING FORCE!

Amazing CFC* Process Sets Impressive New Standards for Connector Performance

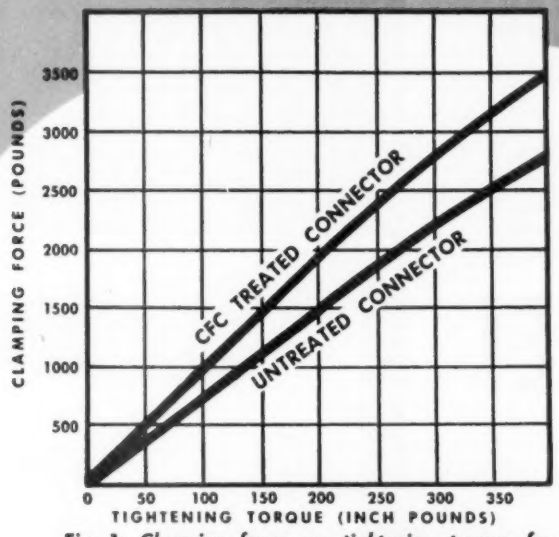


Fig. 1: *Clamping force vs. tightening torque for No. 2 stranded connectors, comparing CFC treated connectors with untreated connectors of the same lot.*

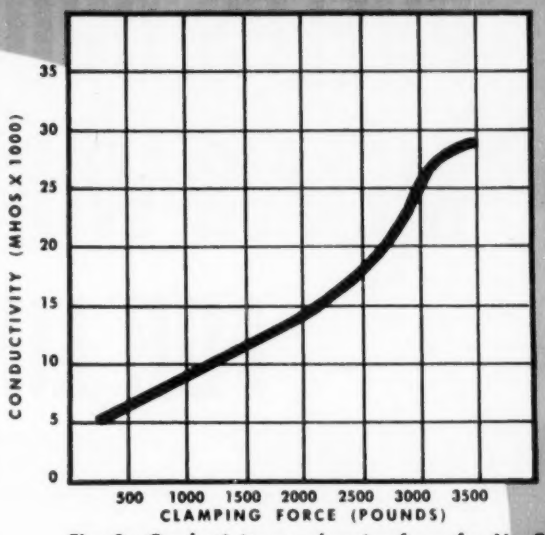


Fig. 2: *Conductivity vs. clamping force for No. 2 stranded hard drawn conductors.*

BLACKBURN'S exclusive chemical process for copper alloy connectors drastically reduces thread friction — increases clamping force — produces lower-resistance connections — and insures lasting, trouble-free service.

The above graphs show the great advantages of CFC treated Connectors. Note over 25% increase in clamping force. Note also how clamping force greatly increases conductivity of the connection. Thus, high clamping force, plus connector strength to **maintain** this **force**, gives you the **ideal** connection.

BLACKBURN Hi-Strength Connectors give you this **extra** clamping force — give you the **extra** strength to **hold** a maximum-pressure connection . . . Result — absolutely **dependable** connections that stay tight and **trouble-free** year after year.

Chemical Friction Control Process—Patent pending

JASPER BLACKBURN CORP.
35 MADISON ST., ST. LOUIS 6, MO.
Phone CEntral 3007

BLACKBURN *Hi-Strength* CONNECTORS

WIRE BY PHELPS DODGE MEANS WIRED FOR LIFE!

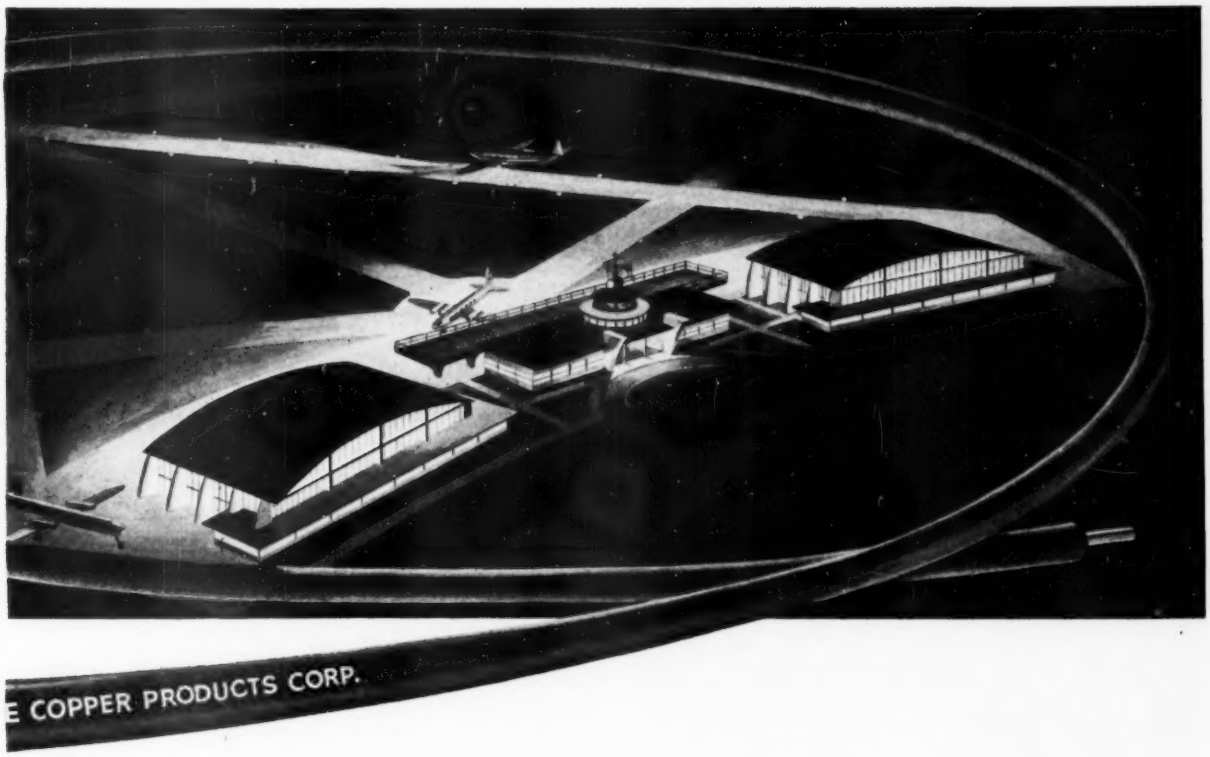
Habirshaw Quality Goes Beyond Specification Requirements—is Checked by Exhaustive Controls and Tests!

Specifying Habirshaw wire and cable—made by Phelps Dodge Copper Products Corporation—is a sure way to boost your own reputation for the highest quality work. Habirshaw's top-grade materials, expert workmanship and careful control of quality throughout manufacture assures owner acceptance and satisfaction!

See Your Phelps Dodge Distributor!

- **Habirite-Habirprene Type RR Series lighting cable** means the very highest standards of quality and dependability under the most difficult service conditions.

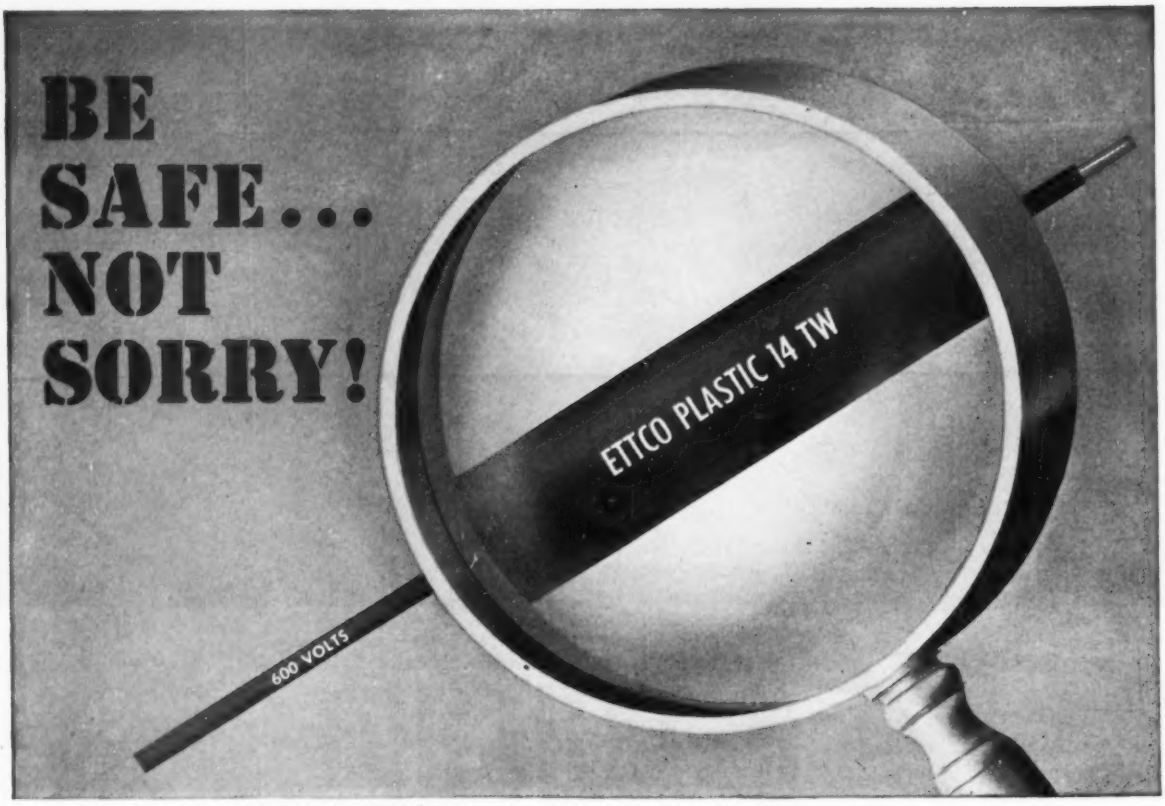
- Quality control and craftsmanship go hand-in-hand. The Phelps Dodge technician below applies 33 years of experience to his job.



Experimental compound of high-voltage rubber insulating material being milled in the extensive research laboratories of the Phelps Dodge Copper Products Corporation's Habirshaw plant.

Checking ozone resistance of Habirite high-voltage butyl rubber insulation.

PHELPS DODGE COPPER PRODUCTS
CORPORATION



SPECIFY Ettco TW BUILDING WIRE

(newest member of the Ettco family!)

- small diameter Thermoplastic Wire resists severe exposure!
- lubricated for easy pulling!
- easiest, cleanest stripping ever!
- saves initial and maintenance costs . . . installation time!
- laboratory tested and inspected!
- packaged in handy cartons!

Representatives and warehouses in the following principal cities:

Atlanta, Ga.	Denver, Col.	Louisville, Ky.	Portland, Ore.
Boston, Mass.	Detroit, Mich.	Minneapolis, Minn.	San Franscico, Cal.
Cleveland, O.	Greensboro, N. C.	New Orleans, La.	Seattle, Wash.
Chicago, Ill.	Houston, Tex.	New York, N. Y.	St. Louis, Mo.
Dallas, Tex.	Los Angeles, Cal.	Philadelphia, Pa.	Syracuse, N. Y.
		Pittsburgh, Pa.	Washington, D. C.

SOLD THROUGH ELECTRICAL WHOLESALERS ONLY

OTHER PREMIUM quality electrical products by

Ettco

- Bushed Armored Cable
- Non-metallic Sheathed Cable
- Flexible Steel Conduit
- Service Entrance Cable

UL

ETTCO Wire & Cable Corporation

General Offices: 46-50 Metropolitan Avenue • Brooklyn 37, New York
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G-E Rapid Start Ballast Now Certified by CBM!

CBM CERTIFIED by ETL

Now, for the first time, you can offer your customers CBM certification in Rapid Start fluorescent lighting. This General Electric ballast, for the operation of two 40-watt Rapid Start lamps, meets the exacting specifications which Certified Ballast Manufacturers have recently designated for Rapid Start operation. Electrical Testing Laboratories subjected this G-E ballast to a series of thorough tests which verified the quality, safety and full-rated performance of General Electric's Rapid Start design.

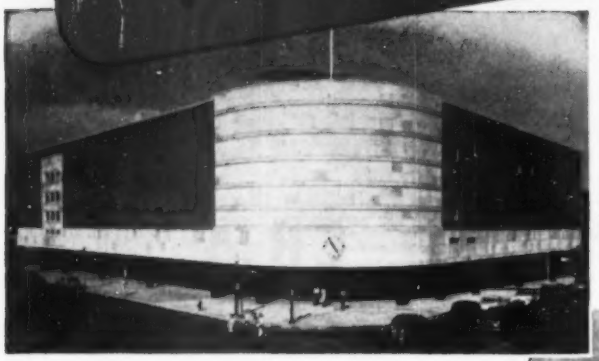
First to introduce fluorescent lighting, in 1938, General Electric again led the way in 1952 . . . in the development, introduction, and first application of Rapid Start lamps and ballasts. Now, CBM certification of this G-E Rapid Start ballast is further evidence of the progress you expect from General Electric—a leader in fluorescent lighting.

For complete information on General Electric's full line of ballasts for fluorescent lamps, contact your nearest G-E Apparatus Sales Office or authorized G-E Distributor. General Electric Company, Schenectady 5, N. Y. 412-108

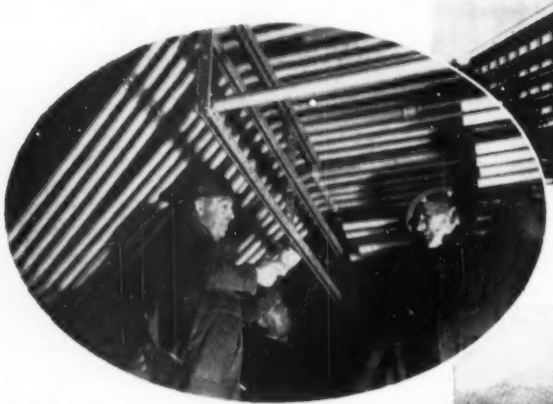
You can put your confidence in—

GENERAL ELECTRIC

ANOTHER MAJOR PROJECT USES ELECTRUNITE E.M.T.



STORES Famous-Barr Company's "Southtown" department store, St. Louis, Missouri. More than 52 miles of ELECTRUNITE E.M.T. protect the lighting and service circuits in this modern, convenient department store.



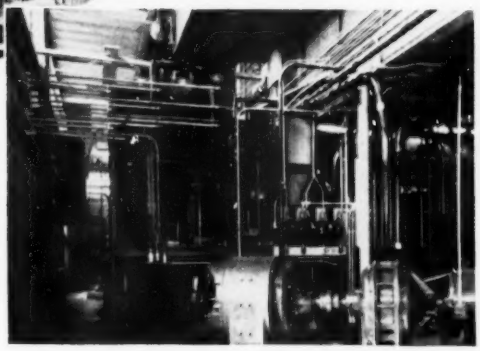
HOSPITALS Atlanta's Georgia Baptist Hospital with its maze of electrical circuits is wired with safe, dependable ELECTRUNITE E.M.T. lightweight rigid steel raceways. All circuits are protected against fire, moisture and mechanical injury.

PUBLIC UTILITIES Pacific Gas and Electric's new Contra Costa steam plant. Electricity is their business and ELECTRUNITE E.M.T. meets their rigid requirements for safety, dependability and sound installation practice.

SCHOOLS Divine Savior High School, Wauwatosa, Wisconsin. Electrical conductors in this modern school are protected from dampness, fire and mechanical damage by ELECTRUNITE E.M.T.

Add Carver Community Housing Project, Atlanta, Ga., to the long list of ELECTRUNITE E.M.T. installations. Number of Dwelling Units, 990. Poundstone, Ayers & Godwin, Architects, Atlanta, Ga. Logan & Williams, Associate Architects, Atlanta, Ga. Fuller & Beckett, Associate Architects, Atlanta, Ga. Locatell-Norris Co., Associate Architects, Atlanta, Ga. J. R. Bracewell & Associates, Electrical Engineers, Atlanta, Ga. J. A. Jones Construction Co., General Contractors, Atlanta, Ga. Knowles Electric Co., Electrical Contractors, Atlanta, Ga.

APARTMENTS "Shaker Towers," Cleveland, Ohio. The electrical circuits, call systems and television leads serving the tenants in this new 92-unit apartment are provided with a grounded system and protected by the steel walls of ELECTRUNITE E.M.T.



INDUSTRIAL P. R. Mallory Company, Indianapolis, Ind., a leading manufacturer of electrical equipment components. Flexibility of power supply circuits is important in factories. ELECTRUNITE E.M.T. is easy to install, easy to relocate.

STEEL AND TUBES DIVISION
REPUBLIC STEEL CORPORATION
212 East 131st Street • Cleveland 8, Ohio
Export Department: Chrysler Building, New York 17, N. Y.

Republic
REPUBLIC STEEL
ELECTRUNITE E.M.T.

INSTALLATION FEATURES

Exclusive "Inch-Marked®" lengths are easier to cut . . . accurately. Using the ELECTRUNITE Bender, electricians can make smooth, accurate bends.

ELECTRUNITE E.M.T. goes in easily. No threads to cut. Connectors and couplings go over the tube to make tight joints . . . without turning the whole raceway or cutting away the galvanizing.

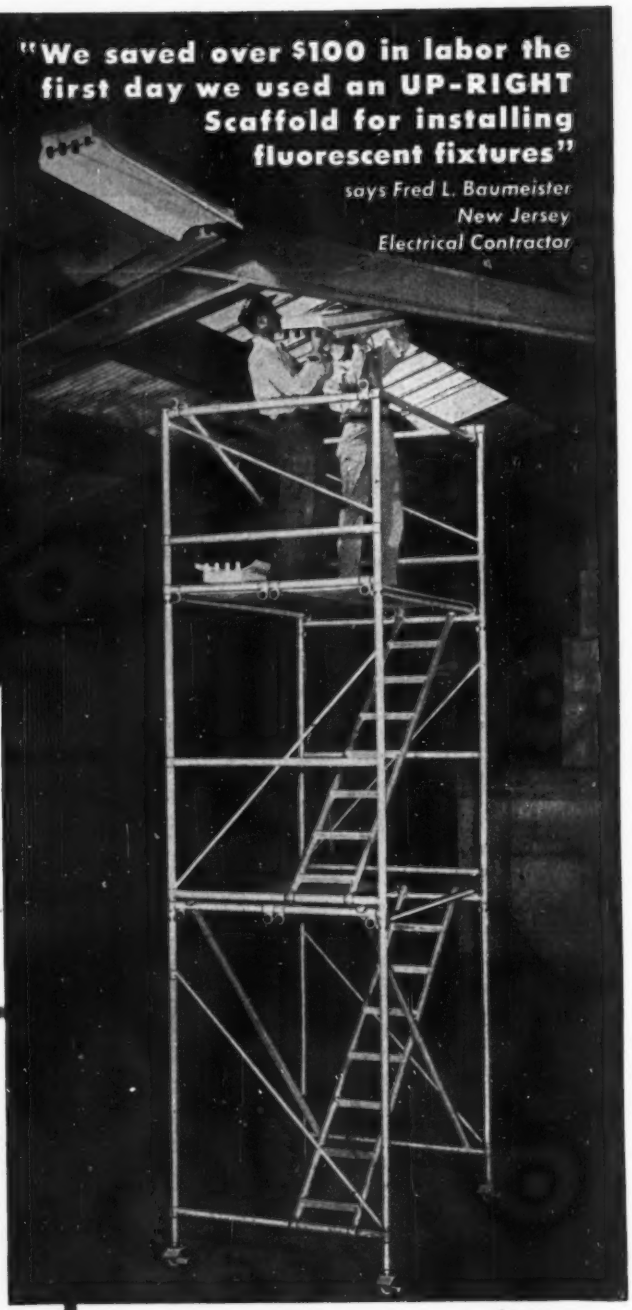
Exclusive inside knurling of the popular sizes of ELECTRUNITE E.M.T. makes wire-pulling up to 30% easier.

Presto... it's UP!

17 ft. "UP-RIGHT" SCAFFOLD-ON-WHEELS set up in only 3 minutes!

"We saved over $100 in labor the first day we used an UP-RIGHT Scaffold for installing fluorescent fixtures"

says Fred L. Baumeister
New Jersey
Electrical Contractor



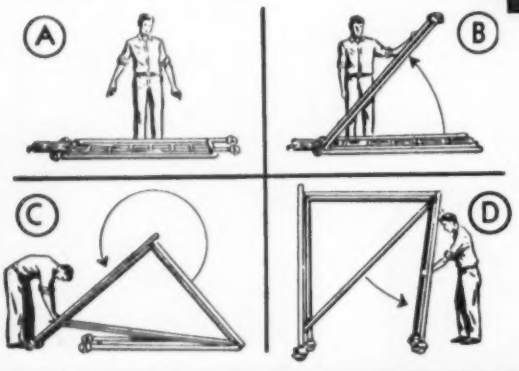
As if by magic, an aluminum alloy tower of any height desired is ready in minutes! Individual scaffold sections are set one on top of the other. Sections lock into place instantly.

HERE'S THE SECRET!...

PATENTED

ONE-PIECE SECTIONS

Each one-piece section is unfolded by one man in less than a minute! No tools, wing nuts or bolts.



Your maintenance costs can be reduced by "UP-RIGHT" SCAFFOLDS

WRITE FOR DESCRIPTIVE CIRCULAR

"UP-RIGHT" SCAFFOLDS

DEPT. 107 • 1013 PARDEE ST. • BERKELEY, CAL.

Factories: Berkeley, Calif. & Teterboro, N. J.

Offices in all principal cities

IF IT'S PARANITE®
IT'S the RIGHT Wire and Cable

PARAFLEX Non-Metallic Sheathed Cable lays flat. Won't squirm or twist. Clean to handle. Plainly marked.

PARAUSE® Type "RR" cable provides permanent underground installation from power line to meter and for connecting several buildings. CAA approved under Specification L824.

HYDRO-THERM® Building Wire combines in a single wire the heat-resistant qualities of Type RH and the moisture resistant qualities of Type RW.

URC Weatherproof Wire and Cable can be relied upon to meet severe climatic conditions. Both actual line and Weather-Ometer tests prove unusual ageing characteristics.

SERVICE ENTRANCE CABLE, Type SE Style U unarmoured and Type SE Style A armoured. There is also a Paranite Service Drop Cable, two conductor, Type SD.

DREADNAUGHT® Heavy Duty Cable has lead-cured neoprene insulation. Flexible, durable, safe, long-lived. Cuts repairs and replacements. Delivers current continuously.

IF IT'S **PARANITE®** IT'S RIGHT!

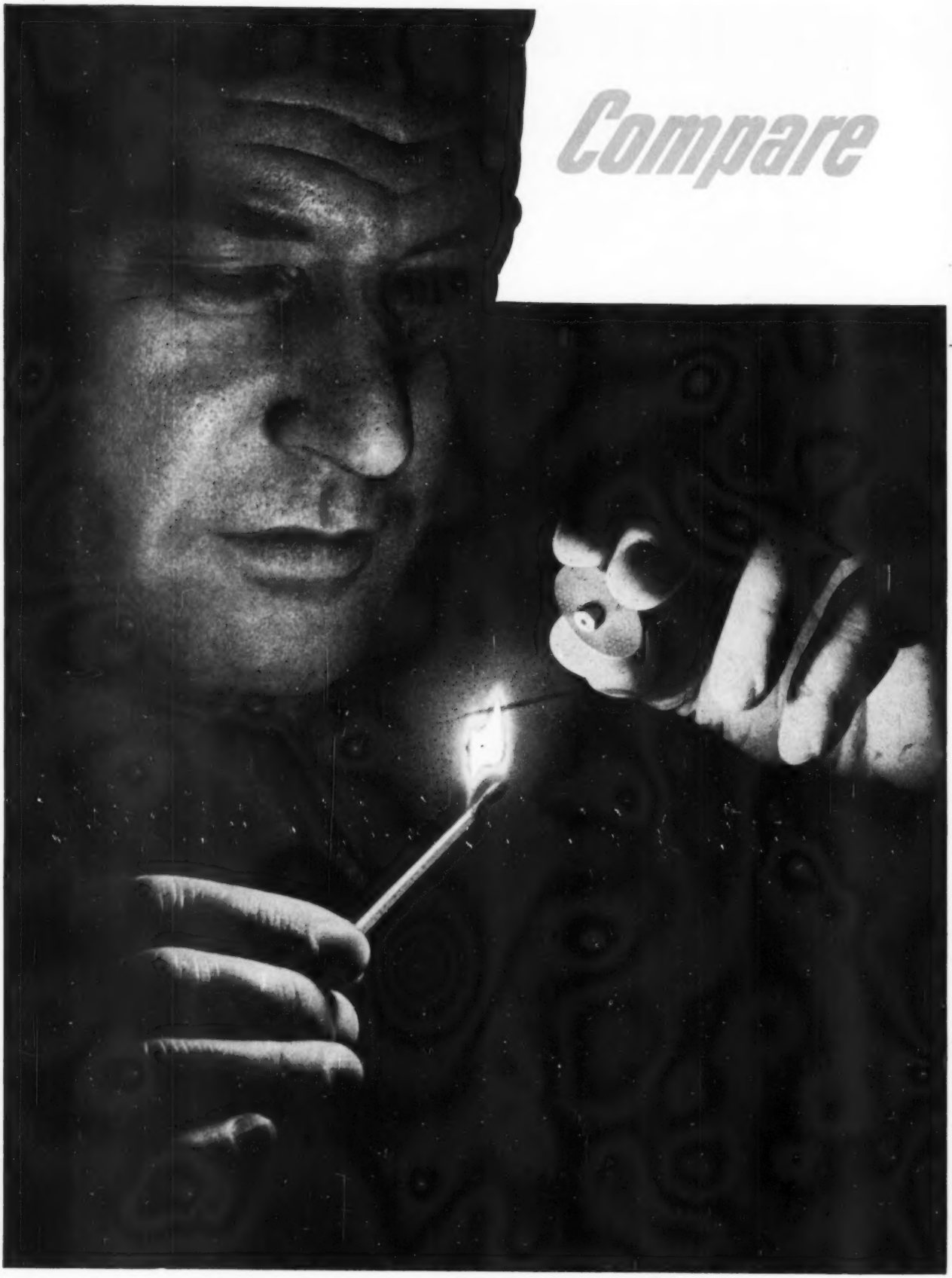
PARANITE

PARANITE WIRE AND CABLE
Division of ESSEX WIRE CORPORATION
FORT WAYNE 6, INDIANA

WIRES AND CABLES SINCE 1890

EXPORT SALES OFFICE—LIONEL-ESSEX INTERNATIONAL CORPORATION, 15 E. 26th ST., NEW YORK 10, N.Y.

ELECTRICAL WIRES AND CABLES *"BETTER THAN CODE REQUIRES"*


Compare

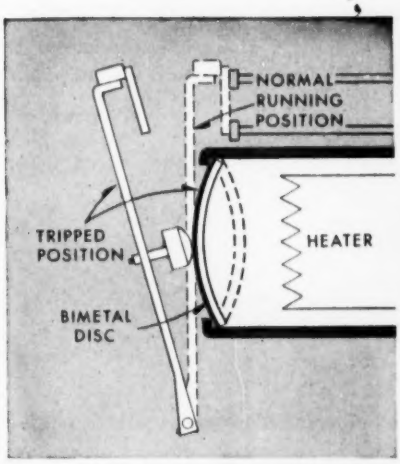
Life-Line starters by this simple demonstration

Proof that Life-Line Starters give you instant, positive motor protection

See this flame test. When heated and placed upon a flat surface, this bi-metal disc will snap up into the air. Here is simple action—demonstrated right before your eyes—powerful, positive action to protect your motors from the destroying heat of dangerous overload.

The bi-metal disc is the nerve center of the overload relay designed into every Westinghouse Life-Line Starter. The disc accurately stands watch over the build-up of motor heat, because a motor can become overloaded. At precisely the right instant, just before a motor may be dangerously overloaded, the disc snaps, as in the flame test. This causes starter contacts to open lightning fast, protecting your valuable motor.

Only Westinghouse Life-Line Starters have the bimetallic, snap-action, disc-type overload relay . . . the most precise motor protective device you can buy. But, just as important, the bi-metal maintains its precision calibration for the life of the starter. It will not fail because it cannot fatigue, age or oxidize. Premature, or "hot" resets can ruin other types of overload relays, such as the solder-pot. Remember—the price of poor protection is smoldering, useless motors, costly motor rewind jobs, other damaged equipment, down time and expensive production pile-ups.



Westinghouse bi-metal principle of overload relay protection, dependable for the full life of the installation.

Proof that Life-Line Starters are tough, maintenance free

Simplicity of design, fewer and more rugged components, only one moving element . . . all spell toughness and long life in Westinghouse Life-Line Starters. Parts that aren't there, can't wear.

Call your Westinghouse Representative to see the flame test. Or write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-30146

YOU CAN BE SURE... IF IT'S Westinghouse

"Talk-Don't Walk"

MODERN BUILDING PLANS SPECIFY COMPLETE INTER-COM SYSTEMS

Good inter-com systems are just as accepted as a part of today's architecture as its modern design. Permanently built-in communication systems naturally include the long-life, trouble-free characteristics provided by Belden Inter-Com Cables.

There is a specialized Belden Cable for every inter-com or sound system requirement.

Belden Manufacturing Co.
4623-A W. Van Buren St.
Chicago 44, Ill.

For *Permanent* Installations
For Profitable Work

FOR EVERY TYPE OF INSTALLATION
FOR EVERY TYPE OF EQUIPMENT
BELDEN HAS THE CABLE BUILT TO
SPECIFICATIONS

Belden Inter-com CABLE

Neither Explosion nor Fire could destroy this KILLARK *Explosion Proof* Fixture

Unscheduled but dramatic proof of Killark's rugged durability and safety-plus design came out of the ruins pictured above.

Both explosive gases and fire joined forces to produce this plant-wide destruction—bricks were literally evaporated under the heat, beams were twisted into grotesque shapes, large tanks were hurled to distant points.

In the *very center* of this broad devastation was the Killark fixture shown here in the unretouched photo! Excluding the sheet metal reflector, of course, the body of the fixture itself came through undamaged—in *still-usable* condition. The gaskets and the seal-off section were still intact, the globe was in perfect condition—there was no invasion of fire into the conduit.

A more severe test for any fixture would be hard to imagine—yet this is the kind of day-in-day-out protection built into every Killark Explosion-Proof Fixture.

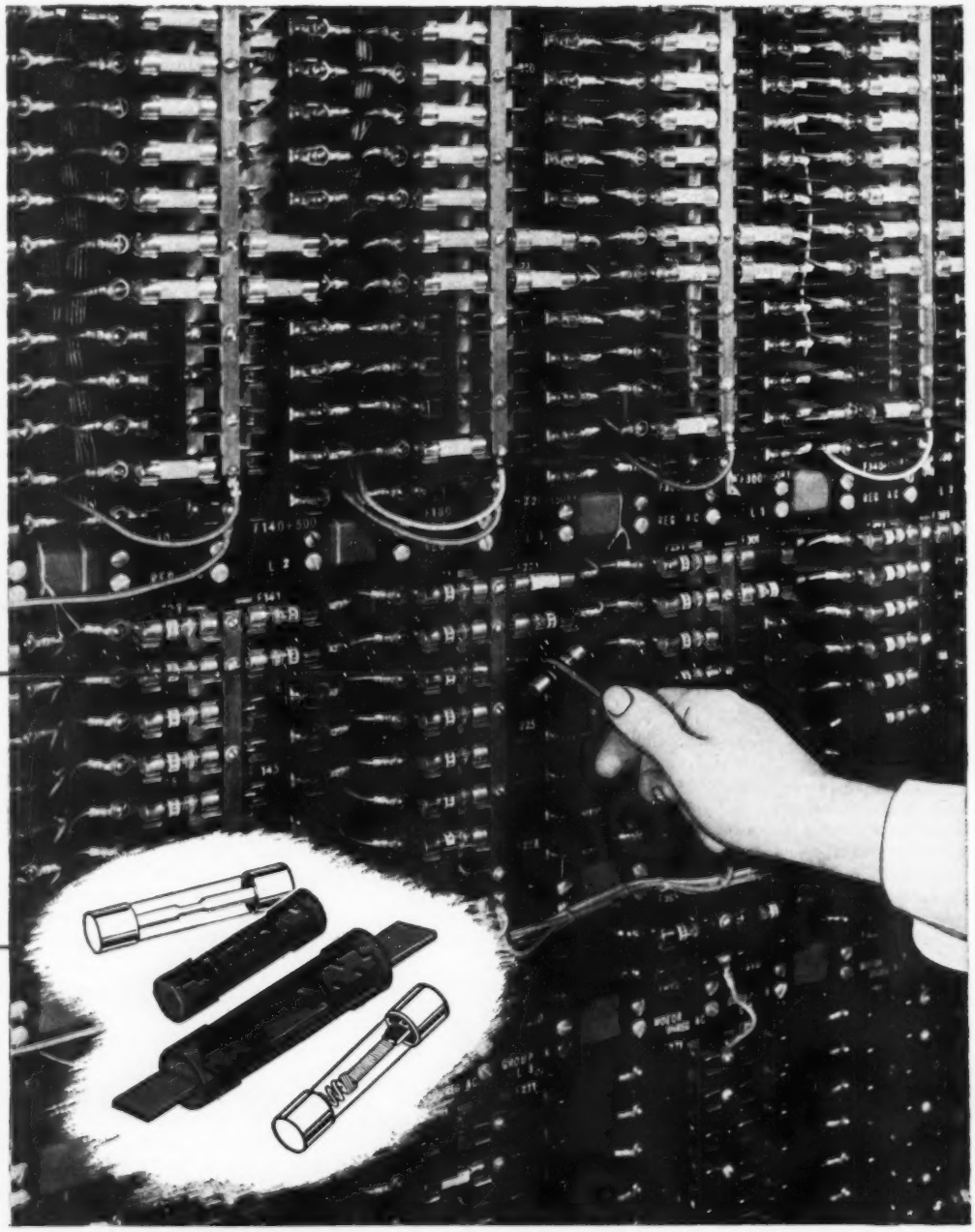
Less spectacular perhaps, but just as important to long-life installations, are these other Killark advantages: rust and corrosion proof Alumalloy construction; smooth attractive finish; light in weight but strong in service; always safe and non-sparking, yet cost no more than ordinary iron fittings.

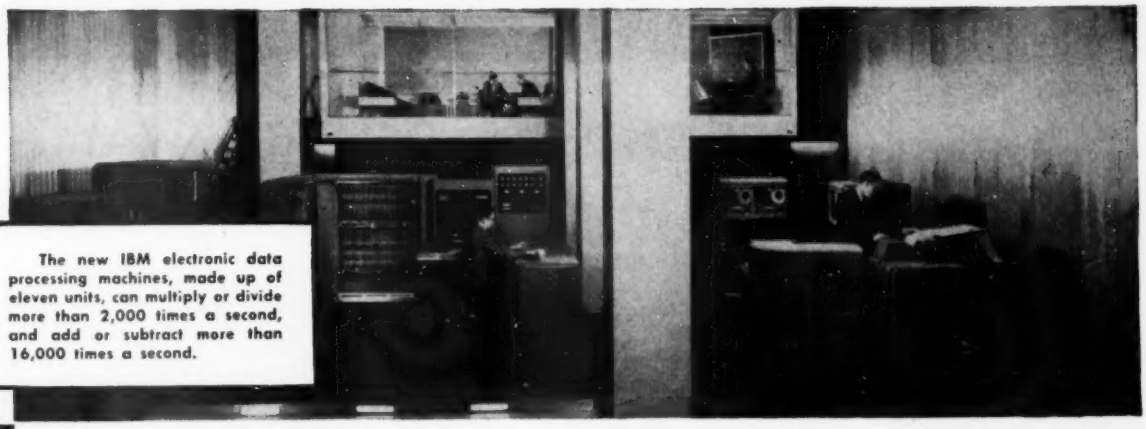
K KILLARK ST. LOUIS *Killark*

"KILLARK—a Fitting Name to Remember"

ELECTRIC MANUFACTURING COMPANY

More Than 400 FUSETRON and BUSS Fuses are used in IBM's Electronic Data Processing Machines





The new IBM electronic data processing machines, made up of eleven units, can multiply or divide more than 2,000 times a second, and add or subtract more than 16,000 times a second.

In these electronic data processing machines, protection of the intricate wiring is of the utmost importance. IBM uses between 400 and 500 FUSETRON and BUSS fuses in each of its new '701' high speed calculators.

On circuits where surge currents might cause an ordinary fuse to blow needlessly, IBM specifies FUSETRON dual-element fuses because of their long time-lag. On other circuits where no surges occur, or where even a short-lived surge might cause damage, single-element BUSS indicating fuses are used for fast opening in case a fault occurs.

When this newest and most powerful high speed electronic calculator was displayed at IBM World Headquarters on March 27th of this year, FUSETRON and BUSS fuses were one of the component parts that made the operation of this spectacular machine possible.

You Can Have The Same BUSS Dependability and Accuracy in Your Plant . . .

FUSETRON dual-element fuses for the protection of industrial and commercial circuits are made with the same precision demanded for this ultra-modern IBM equipment. That's why FUSETRON fuses, used throughout the entire electrical system give you a degree of protection obtained with no other device.

And, don't forget — FUSETRON fuses not only give you protection against short-circuits, they give 10 point protection: 1. Protect against short-circuits. 2. Protect against needless blows caused by harmless overloads. 3. Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation. 4. Provide thermal protection — for panels and switches against damage from heating due to poor contact. 5. Protect motors against burnout from overloading. 6. Protect motors against burnout due to single phasing. 7. Give double burnout protection to large motors — without extra cost. 8. Make protection of small motors simple and inexpensive. 9. Protect against waste of space and money — permit use of proper size switches and panels. 10. Protect coils, transformers and solenoids against burnout.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

Start Saving With Fusetron Fuses

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University at Jefferson, St. Louis 7, Mo.
(Division of McGraw Electric Co.)

Please send me complete facts about FUSETRON dual-element fuses.

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Title .....
Company .....
Address .....
City ..... State .....

BUM-953

*FUSETRON is a trade mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.

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PRECISION MANUFACTURING

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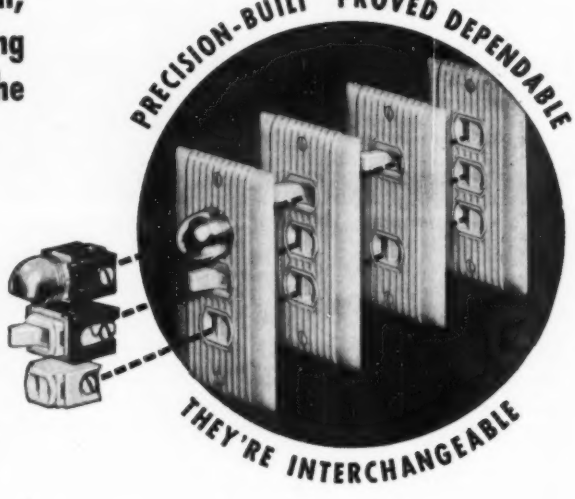
WIRE THE P&S® DESPARD WAY...

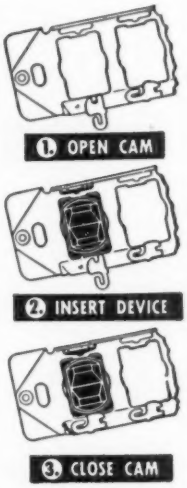
with the most modern, the smartest-appearing wiring devices on the market today . . .



Here's How You Benefit

- Combinations of two or three compact, "specification" type P&S-Despard devices can be assembled under a single gang wall plate. You save on boxes — and on multi-gang wall plates.
- Practically any desired combination can be made up *right on the job* from a small stock of standard catalog numbers — no long waits for special combinations or special plates.
- P&S-Despard *interchangeability* makes it possible to give prompt service with a relatively small inventory — quicker turnover of your investment.
- The P&S-Despard Line gives you something to SELL — not just switches and outlets — but smart-appearing, compact combinations — modern, adequate wiring that looks good and *is good.*
- The P&S-Despard Line is not cheap — BUT IT IS ECONOMICAL. You can install *quality, "specification" type devices — T-rated switches, double grip outlets* — for *only a few cents more,* due to the savings on boxes and wall plates. Where low cost is the prime consideration, use residential type switches (1391 Line). You'll find a one-gang installation of two 1391 switches will cost less than a two-gang installation using competitively priced strap type switches — and you'll have a better looking job.

Assemble combinations quick-as-a-flash with the new Camstrap



Why Not Investigate the Possibilities of Wiring the P&S-Despard Way?

Write Dept. M. for complete information.

P&S TIME-TESTED DEPENDABILITY

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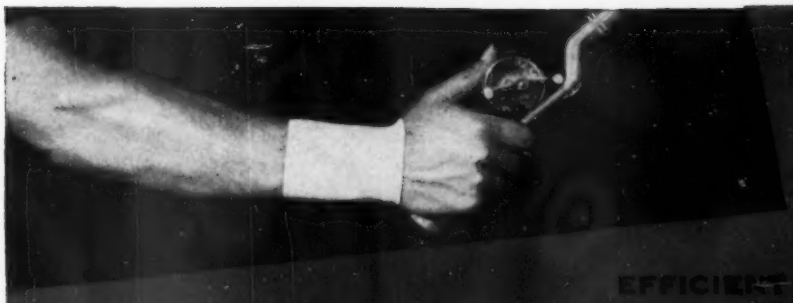
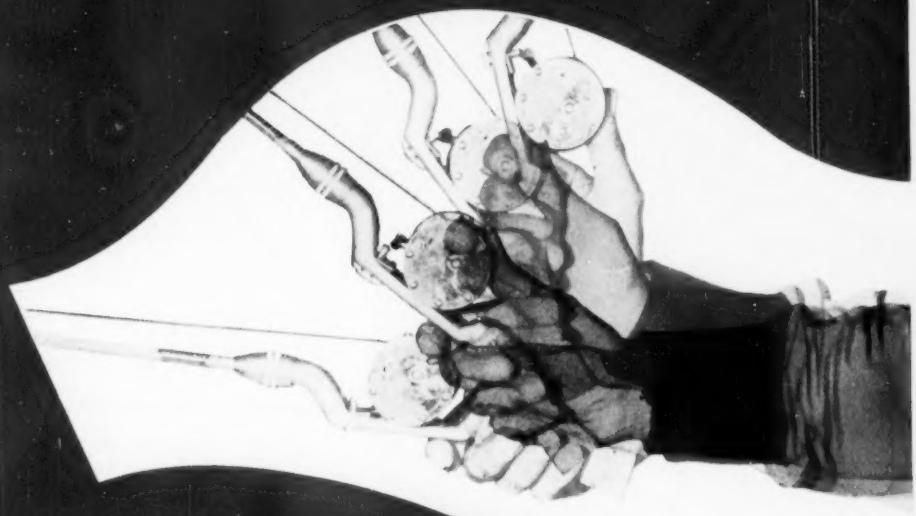


EFFICIENT FISHIN'



. . . with a casting rod depends on a flexible wrist. If your wrist were taped up tightly, you could not cast far, would soon tire out.

Likewise, a portable cord or cable must be free to flex easily and repeatedly if it is to give top performance.

BRONCO 60 Certified

portable cord and cable

flexes as freely as your naked wrist. Vulcanized by a unique Bronco process, it is never subjected to high molding pressures which tend to bind the finished cable like a tight bandage. The Bronco way of making cable results in greater flexibility — hence, less internal friction, less internal stress and strain. Bronco vulcanization makes Certified more resilient, too, so that it "gives" under shock and impact like a super-balloon tire. Even though it is flexed, bent, and twisted day after day . . . even though it is crushed under heavy loads and rolling wheels, Bronco 60 Certified stays steadily on the job, delivers years of faithful service. With a branded jacket Certified to contain not less than 60% by weight of Neoprene, and with super-aging Cold Rubber insulation, Bronco 60 Certified is certainly your best buy.

get Bronco 60 Certified for flexibility, for resilience, for long life.

BRONCO 60 CERTIFIED IS AN ACHIEVEMENT OF WESTERN INSULATED WIRE CO.
Los Angeles 58, California.

CUT voltage loss to a minimum

with re-designed high efficiency feeder busduct

IT'S THE LAST WORD in efficient, flexible and economical power distribution from service entrance to distribution center, from generator to switchboard and from switchboard to distribution center.

Re-designed, inside and out, to assure maximum efficiency, FA High Efficiency Feeder Busduct has proven, in actual tests, that it will *reduce voltage loss to less than 2 volts per 100 feet at 80 percent power factor.*

Made for either indoor or outdoor installation, this new, more efficient method of power transmission has smaller size enclosures, less weight, and perforated sectional covers — top and bottom — for maximum heat dissipation.

Conductors are insulated with varnished cambric tape and plastic type tape for maximum protection. Joints are electrosilver plated (by immersion) for better low resistance contact and secured by either two or four brass jam bolts that fit into elongated fastening holes to allow for expansion, and phosphor bronze-cupped washers to maintain pressure.

The fact that sections can be run either vertically or horizontally, up and around pipes and other difficult angles and through walls, floors and ceilings, makes this type FA Feeder Busduct even more desirable.

FA High Efficiency Feeder Busduct is available in capacities, from 600 to 4,000 amps., 600 volts single phase for welder service, three phase for power, three-phase, four wire service for light and power.

For additional details, consult your nearest FA representative listed in Sweets. He'll gladly tell you more about this modern, more efficient system of power and light distribution.

Frank Adam Electric Co.

P. O. BOX 357 ST. LOUIS 3, MISSOURI

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Makers of BUSDUCT • PANELBOARDS • SWITCHBOARDS • SERVICE EQUIPMENT • SAFETY SWITCHES • LOAD CENTERS • QUIKHETER

BRITONS CAN HAVE PROSPERITY —If They Want It

What is required to get Britain, our key ally in the grand alliance of the free world, firmly back on her economic feet? The purpose of this message is to throw light on this crucial problem, which afflicts our other European allies also.

At the moment, Britain is enjoying a respite from the economic crises (of 1947, 1949 and 1951-52) which have plagued her postwar course. This respite may well continue for some time. But almost no one whose judgment is trustworthy believes that Britain has acquired sufficient economic strength to safeguard her against further economic crises in the years immediately ahead.

Two British Views

New and clear light on what should be done to that end has recently been shed by two noteworthy British publications. One is a book, "We Too Can Prosper," by Graham Hutton, distinguished British economic writer and administrator. The other is an article, "The Riddle of Prosperity," published by THE (London) ECONOMIST, Europe's most eminent economic journal.

Combined, these two publications present in sharp relief the basic problem that must be handled successfully if Britain is to be safely solvent. As is implied by its title, ***the Hutton book demonstrates that Britain can be made prosperous by readily feasible procedures, patterned on what has been done in the United States, to increase its industrial efficiency. But, says THE ECONOMIST, with Mr. Hutton's book in mind, this is not the most basic problem, which is, "How shall we make the British people determined to be prosperous?"*** This is a problem of incentive or motivation.

Compared with that of the United States, average industrial efficiency in Britain, as in most of Western Europe, is low. In his book Mr. Hutton remarks that "fifty years ago an American industrial worker turned out roughly the same amount in a day as his opposite number in Britain, Germany or France. . . . Today, he turns out from two to five times as much."

In large part it is this lag in output per hour or "productivity," as the technicians call it, which makes Britain and other key countries in Western Europe a continuing prey to economic crises. Moreover, the great disparity in productivity between the U.S.A. and most

of Western Europe is a major barrier to knitting the free world into a smoothly working economic whole. As one observer put it, "when the American economy catches a cold, the European economy gets pneumonia." This is largely because Europe is so much weaker in productive strength.

No Shortage of Knowledge

Yet the knowledge which would enable the countries of Western Europe, and particularly Britain, to increase their industrial productivity has been mobilized and is readily available to them. It is with this process for Britain that Mr. Hutton's book is concerned. In the book he summarizes the findings and conclusions, virtually all of them unanimous, of 66 teams, composed of British industrial managers, technicians, shop workers and labor leaders. Over a period of three years these teams completed a comprehensive series of inspection and study trips in the United States under the sponsorship of the Anglo-American Council on Productivity. The product of that effort, he remarks, is "a set of documents the like of which, on such a scale and of such practical value, has never been seen in the history of international and cultural borrowing."

Psychology the Key

From study of these documents, Mr. Hutton concludes that better capital equipment is the key technical ingredient of higher industrial productivity in Britain, and constitutes "the most urgent . . . need of British industry." But he finds that ***even without new capital equipment a "15% rise in productivity can still be achieved by reorganization of work," and that such an increase would "solve Britain's chief social and economic problems."***

Then why is not such an increase in productivity, demonstrated by the Anglo-American productivity teams to be so clearly within technical grasp, promptly forthcoming? Mr. Hutton, quoting one of the team reports, remarks that, ***"'the greatest obstacles to increased productivity are psychological rather than technical.'*** We have to deal first and foremost with men, not machines." And THE ECONOMIST, pursuing the line of inquiry suggested, reaches the conclusion that, by and large, the people of Britain do not want to prosper by being more efficient. THE ECONOMIST says:

> "The real secret of American productivity is that American society is imbued through and through with the desirability, the rightness, the morality of production. . . . But in Britain, if any moral feeling at all survives about economic matters, it is usually a vague suspicion that economic success is reprehensible and unworthy. From this difference in attitudes everything else follows."

"How," asks THE ECONOMIST, "shall we set about restoring some belief in the rightness of effort, the morality of success?" For this question it has no ready answer. Neither have we. We are confident that the British people will neither be cajoled nor coerced into trying to match our productivity. Basically the problem seems to be to demonstrate clearly to them the truth of the proposition, set down by Graham Hutton, that "there is no goal, aim or end before a Good Society which the raising of that society's material productivity cannot render easier of achievement." Doing that in an old and settled country like Britain is obviously an extremely formidable undertaking. But ***until it is done, the crucial job of getting Britain and the rest of Western Europe firmly on its economic feet will remain to torment all of us.***

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1878 75 1953
YEARS OF ELECTRICAL PROGRESS

Why rotors don't fail in G-E TRI CLAD motors

REG U.S. PAT. OFF.

G-E pioneering and research developed and produced this one piece cast-aluminum rotor winding, which has virtually eliminated rotor failures in Tri-Clad motors.

Rotor is indestructible in service because the bars, end rings, and fans are a "one-piece" casting. No brazed joints, no fabricated fans to come apart.

Rotor inertia is reduced by the lightness of the aluminum, thus raising efficiency and allowing easier starting, stopping and reversing.

Rotor efficiency is higher, operating losses reduced, as the result of a special chemical treatment.

The motor runs cooler because the integrally cast fans dissipate heat faster.

Operation is smooth and quiet due to the dynamic balancing of the rotor which also reduces bearing wear and material fatigue.

Long rotor life is one more reason why G-E Tri-Clad motors last longer — give you more reliable service and greater operating economy.

Order Tri-Clad motors today from your nearby G-E representative. You'll find popular models in stock. General Electric Co., Schenectady 5, N. Y.

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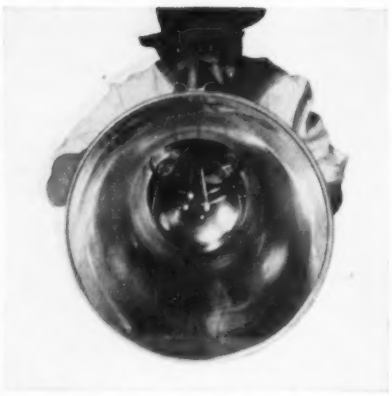
You can put your confidence in—

GENERAL ELECTRIC

1 NO TOOLS required for initial positioning or maintenance with built-in wrench-type handle. Large area clamping action holds against vibration.



2 EASY AIMING is possible even during daylight with G-E L-69's convenient beam sight ... puts the light in the right place, cuts down on installation time.

3 EASY CLEANING to remove particles in case of lamp breakage is possible as the reflector tips over completely. No tools required for the operation.

5 reasons why G-E L-69 Floodlights cost you less to install and maintain

EASY INSTALLATION. You save money by saving time when you install economical G-E Type L-69 1500-watt Floodlights. From the simple two-bolt mounting to the convenient beam sight for fast daylight aiming, the lightweight G-E L-69 is designed so that it will cut your costs by simplifying your installation.

ECONOMICAL MAINTENANCE. Built-in wrench type handle on the G-E L-69 completely eliminates the need for tools. Both relamping and cleaning are fast and easy, and the G-E L-69 delivers more light per unit, more light per watt, than any other comparable lighting unit.

LONG LIFE. The G-E L-69 is constructed completely of aluminum and other non-corrosive metals which will stand up under all weather conditions. This long life construction will save you and your customers money, because it costs you less to maintain these floodlights. With the G-E L-69 you can do a quality lighting job that will pay off in more lighting business for you.

PROMPT DELIVERY. You can get the G-E L-69 right out of distributors' stocks at shipping points throughout the country. There's a light in G.E.'s complete line of open and enclosed floodlights to precisely fit your needs whatever your lighting requirements are. And if you need help, you can get it from G.E.'s staff of lighting specialists.

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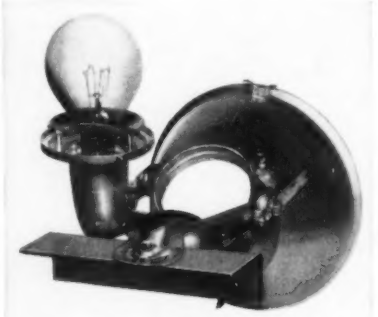
USEFUL INFORMATION is yours for the asking. NEMA approved floodlighting plans for all sports are contained in GET-1284; effective industrial uses are explained in GEA-3640D; and Bulletins GEC-533B and GEC-919 give complete details on the L-69 sports and area floodlight. Just write Section 451-183, General Electric Company, Schenectady 5, New York.

You can put your confidence in—

GENERAL ELECTRIC

4 LESS BREAKAGE with spun-on, impact resisting tempered plate glass, which won't break if struck by ball, and keeps water, dirt and insects out permanently.



5 EASY RELAMPING. Flick hand toggle latches, clamp socket housing to trunnion bracket. Hands are free to service light. Reflector need not be disturbed.

Every foot of RoZone-RoPrene power cable on these reels was corona level tested to assure dependable operation in one of the nation's biggest steel mills. This standard factory testing procedure is one of the big reasons why Rome insulated cables are specified for many critical jobs.

Rome's Corona-Ionization test gives *extra* protection

Specially designed ionization detector for routine factory use measures corona level of all high-voltage rubber insulated cables.

Perhaps you have had the costly experience of installing a reputably high-quality rubber insulated power cable manufactured by a reliable supplier . . . only to have it fail prematurely for apparently no good reason.

Yet, one of the major possible reasons could be . . . internal ionization. This hazard is caused by electrical breakdown of air within the insulation, or especially where it has not been closely fitted to the conductor surface or shield.

Several destructive effects may result from ionization. Included are possible ozone cutting, reduced dielectric strength, and a substantial increase in dielectric losses. *And there is no way of detecting ionization through the visual, physical and routine electrical tests usually applied to cables.*

But you can depend on maximum protection against ionization when you specify Rome power cables. *Every foot of Rome insulated cable, rated at 3000 volts or over, is thoroughly tested by a specially designed ionization detector.* This instrument accurately measures the corona level of the entire cable to assure the ionization voltage exceeds the intended operating voltage of the cable.

This is one more extra step in Rome Cable's standard manufacturing procedure that assures dependability. This completely *NONDESTRUCTIVE* method of testing was developed by Rome Cable engineers and was first described in AIEE paper 48-198, "The Measurement and Investigation of Ionization Level of Rubber Insulated Cables," presented in August, 1948.

Oscilloscope trace indicates ionization within an insulated cable.

It Costs Less to Buy the Best

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Please send me a copy of ..... AIEE paper 48-198
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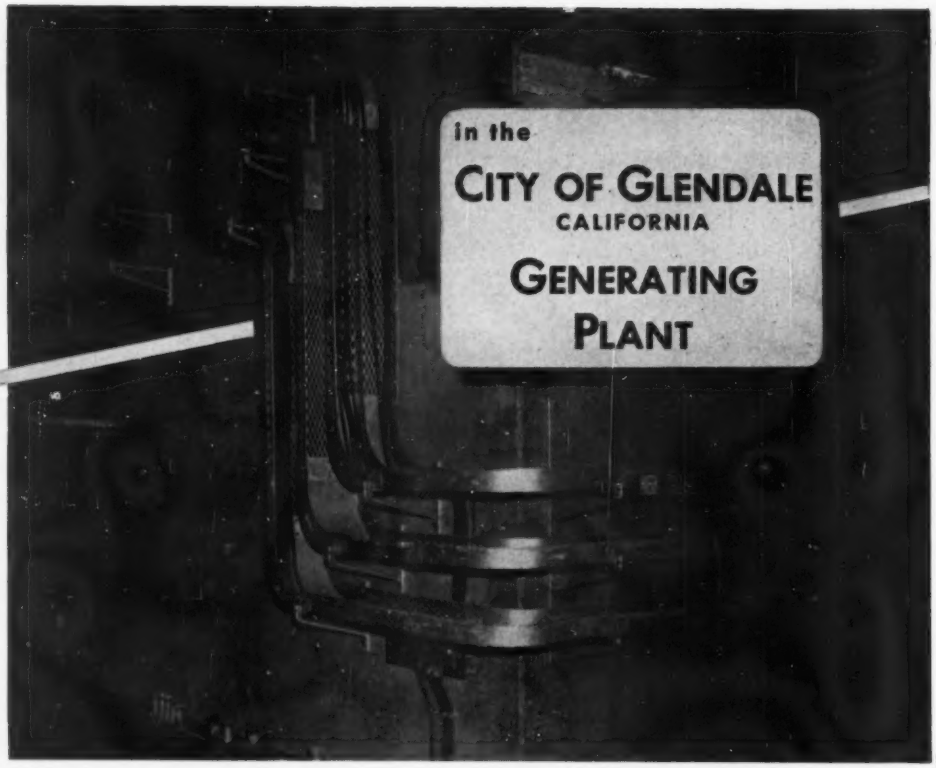

Cope CABLE TROUGH AGAIN PROVES ITS

... Simplicity of Installation
... All-around Economy
... Accessibility to Cable

The versatility and simplified design of the Cope system of Cable Trough and Fittings make it readily applicable to any layout. This is clearly seen in the above photograph showing part of a recent installation at the Glendale Generating Plant. Notice how the Cope Trough is supported by simple wall brackets. Observe, too, that both vertical and horizontal runs are made with standard trough and fittings — turns, branches and reductions.

The High Voltage sign on the top tray emphasizes another Cope Trough feature. Here 480 volt Neoprene jacketed power cables are carried in the same tray with control cables. A barrier strip provides adequate separation while permitting easy access to the lines. The lower tray will carry 2400 volt Neoprene jacketed power cables and ultimately will be equipped with a solid Cope Trough cover. Future expanding needs will be met by adding a fourth tray above the other three.

Learn how you, too, can cut cable installation costs and labor . . . write for bulletin on Cope Cable Trough.

T.J. Cope INC.

You know Cope by these products

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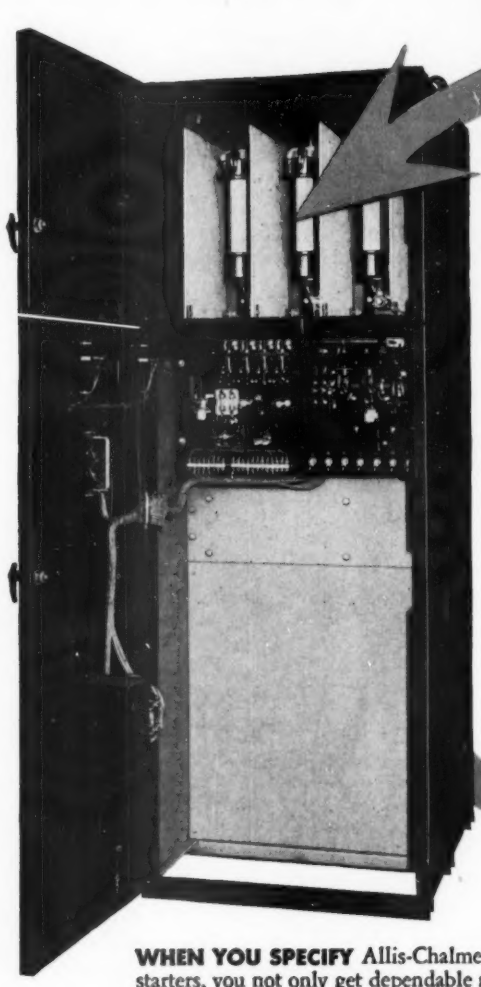
ALLIS-CHALMERS

Type H Starters

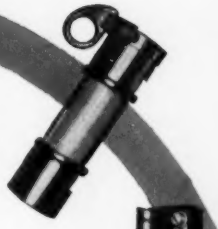
FOR 2300 TO 5000 VOLT MOTORS

Give YOU Full Protection



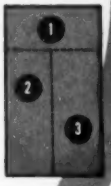
SHORT CIRCUIT PROTECTION

Current-limiting fuse clears short circuit in less than ½ cycle . . . long before the short has had time to harm contactor or motor. Blown fuse emits no gas, flame nor vapor, discharges no metal. Flashover caused by ionized vapor is eliminated.



OVERLOAD PROTECTION

Type 194 thermal overload relay automatically adjusts for ambient temperatures — trips only on motor overload. Prevents unnecessary motor outages. Allows use of maximum capacity, but prevents dangerous motor overloads. Can be adjusted to plus or minus 20% of rated current.



Side View of Cubicle

PERSONNEL PROTECTION

The steel cubicle is divided into three compartments for maximum personnel protection. 1 — Upper front compartment encloses disconnect type fuses. 2 — Lower front compartment houses low voltage control devices. 3 — Rear compartment contains high voltage equipment, contactors, buses, intrument transformers, etc.

TIME DELAY UNDERVOLTAGE PROTECTION

Should an undervoltage occur, the line contactor opens. During a predetermined period, relay remains closed to permit restarting of motors when power is restored.

WHEN YOU SPECIFY Allis-Chalmers Type H starters, you not only get dependable motor control, but you are assured of an all-important "plus"— FULL PROTECTION for man, motor and machine. Positive protection as engineered into Type H starters permits men to work in complete safety... protects motors and machines from costly damage . . . lengthens equipment life . . . increases production by reducing downtime. Get all the facts from your nearby A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3982

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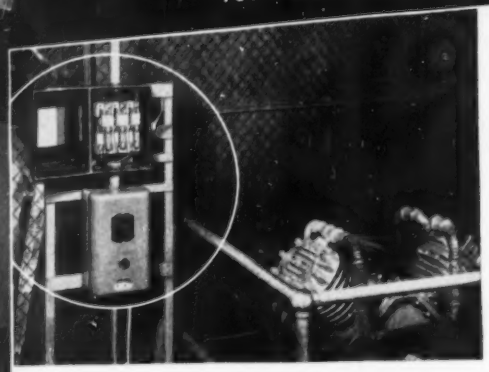
for FUSE ECONOMY . . . use ECONOMY FUSES



Extra Protection for "OFF and ON Circuits

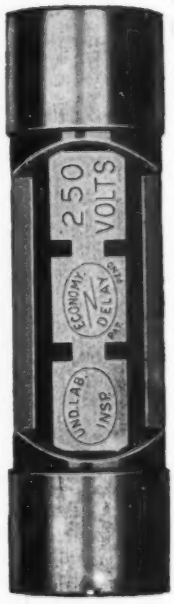
On this air compressor circuit—a typical example of high starting torque—the motor goes on-and-off approximately 120 times in the course of a 10-hour day.

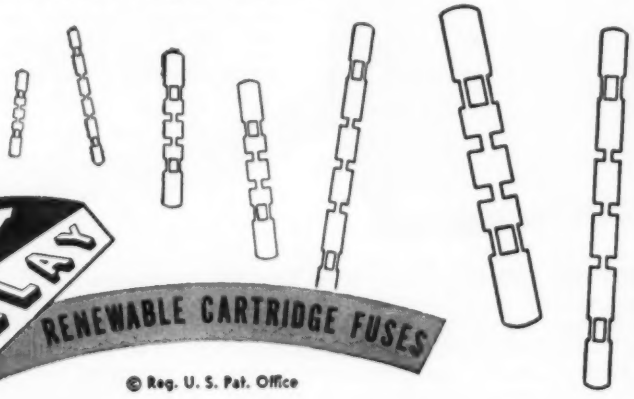
The "ECONOMY DELAY" Fuses shown in this application, operating under these extreme conditions, have blown rarely. If a fuse does blow, all that is required to restore the original fuse efficiency is to insert a new "ECONOMY DELAY" Renewal Link. This requires only a minute or two—which means minimum "down time"... and the cost of an "ECONOMY DELAY" Renewal Link is 3 cents per blow!

The life of an Economy Fuse Cartridge is practically infinite, so, you save money on fuse maintenance and at the same time conserve scarce brass and copper.

Give the extra protection of "ECONOMY DELAY" Fuses to all your circuits. Your wholesaler has "ECONOMY DELAY" Renewable Fuses and Renewal Links in stock.

Ask for the ECONOMY Catalog and Price List.





ECONOMY DELAY RENEWABLE CARTRIDGE FUSES

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ECONOMY FUSE AND MFG. CO., 2717 GREENVIEW AVE., CHICAGO 14, ILLINOIS

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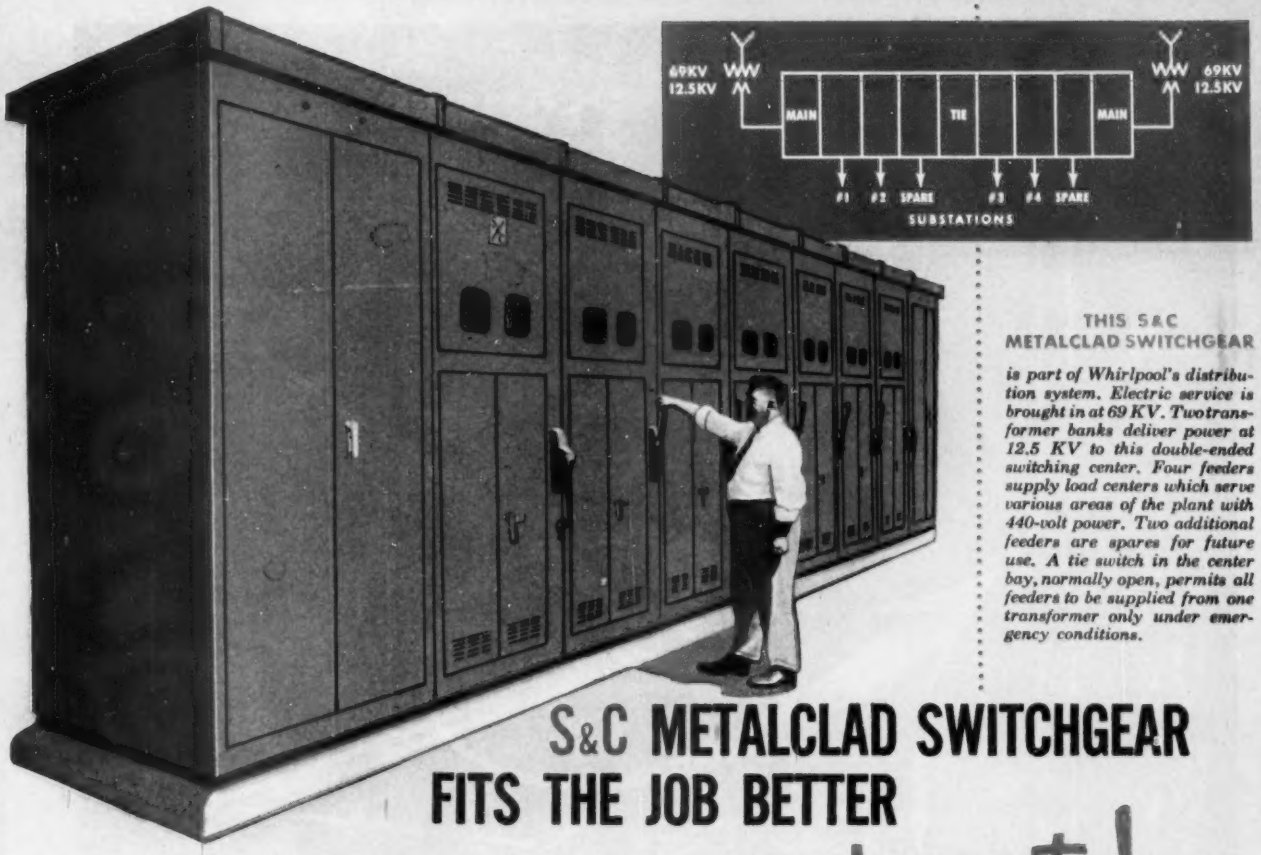


THIS S&C METALCLAD SWITCHGEAR

is part of Whirlpool's distribution system. Electric service is brought in at 69 KV. Two transformer banks deliver power at 12.5 KV to this double-ended switching center. Four feeders supply load centers which serve various areas of the plant with 440-volt power. Two additional feeders are spares for future use. A tie switch in the center bay, normally open, permits all feeders to be supplied from one transformer only under emergency conditions.

S&C METALCLAD SWITCHGEAR FITS THE JOB BETTER

...and it saves half the cost!

When Whirlpool Corporation recently acquired a plant in LaPorte, Ind., for the manufacture of aircraft parts, a new electric service had to be provided to meet the new requirements.

Koontz-Wagner Electric Co., Inc.—contractor-engineers of South Bend—were assigned to engineer and install the necessary equipment.

As part of the main substation, Koontz-Wagner selected S&C Metalclad Switchgear to provide fault protection and switching . . . because investigation showed it was not only adequate for every need, but that alternate equipment would have been larger and more cumbersome, required more ground area, a larger pad, and would have cost more to install and maintain.

With S&C Switchgear the cost was less than half; and now there are no batteries to maintain, no oil to change.

Information about S&C Switchgear is contained in this booklet . . . we would like to send you a copy.

ROBERT L. PFEIL

is Secretary and Assistant Construction Superintendent of Koontz-Wagner. He says, "Our work is almost altogether connected with industrial plants and public buildings. Because of our long and valuable experience in this field, we prefer to do our own engineering, and give our customers full advantage of our experience and know-how. We thus can be sure that the installation is entirely adequate, and frequently we are able to make substantial savings, as we did at Whirlpool."

S&C Electric Company
4433 Ravenswood Ave., Chicago 40, Illinois

Please send me your new booklet on **S&C Metalclad Switchgear.** No obligation on my part, of course.

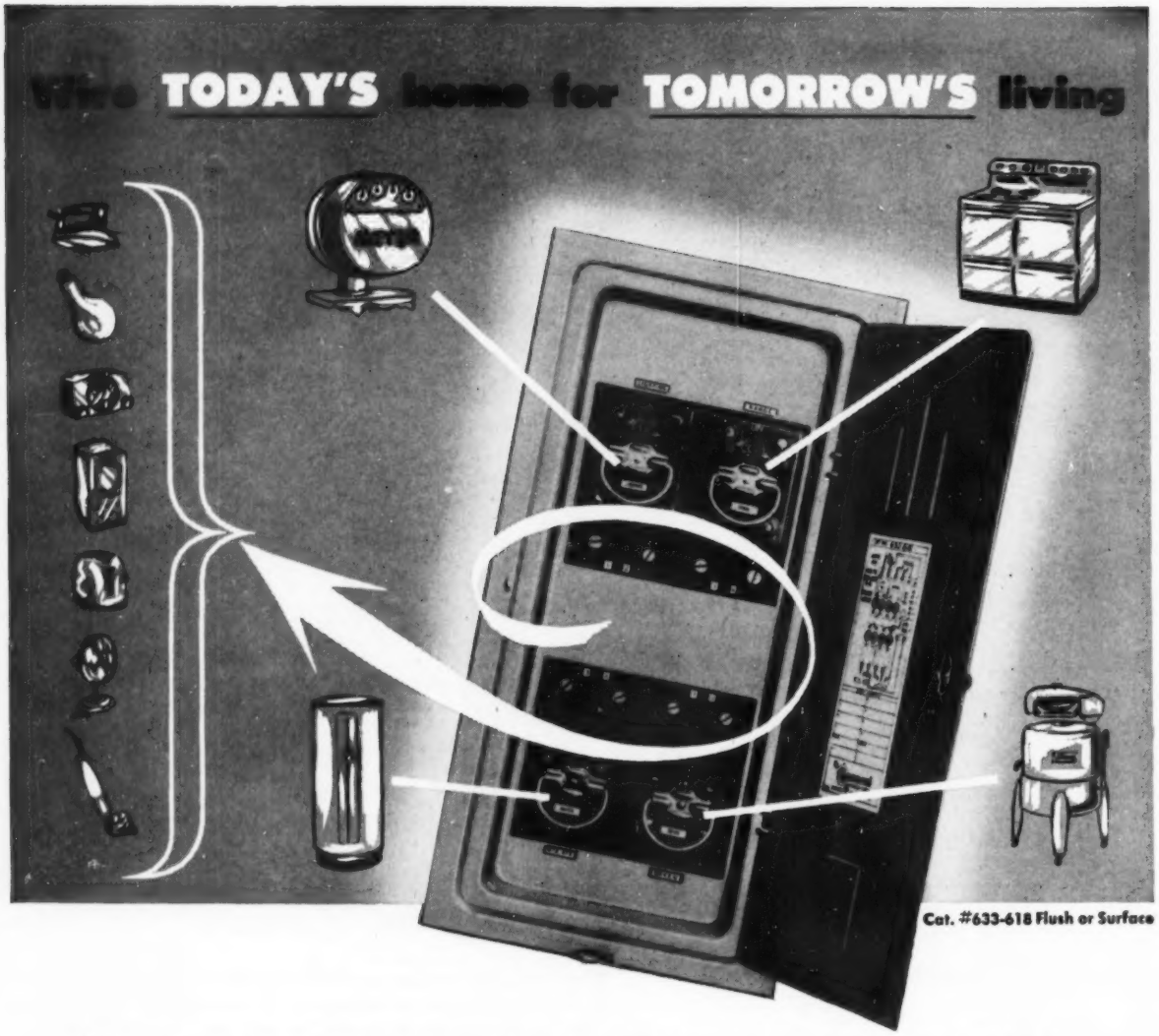
Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

Wire TODAY'S home for TOMORROW'S living



Cat. #633-618 Flush or Surface

General brings you a "Main and Range Plus"! The *quadruple* pullout unit that actually plans for the future. Not only does this all-in-one unit take care of today's wiring requirements . . . it *anticipates* tomorrow's needs. Eliminates costly auxiliary wiring equipment, and unsightly additions. The General Quadruple Pullout unit is neat, compact, thoroughly dependable. It saves you time and materials . . . at a price you want to pay. No wonder wholesalers and contractors all over the country are saying: Switch to General today! Available everywhere exclusively through wholesalers.

100 Amp. main lugs feed 4 pullouts connected in parallel. One 60 Amp. functions as a main disconnect for eight 30 Amp. plug-fuse branch circuits and the 60 Amp. sub-feed lugs. Three additional pullouts (one 60 Amp. and two 30 Amp.) control appliances such as, Ranges, Water Heaters, Dryers, etc. Other combinations may be ordered.

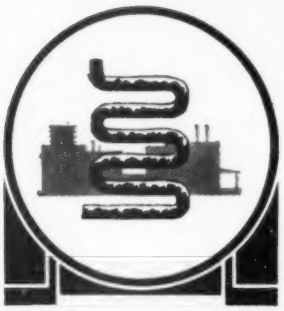
Sales Offices in every Major City

General Switch Corp.

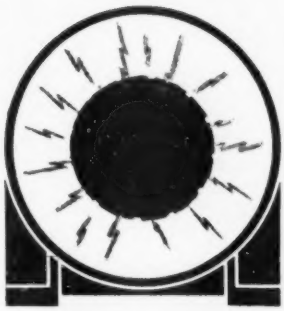
Write for catalog #5201

45 ROEBLING ST. • BROOKLYN 11, N. Y.

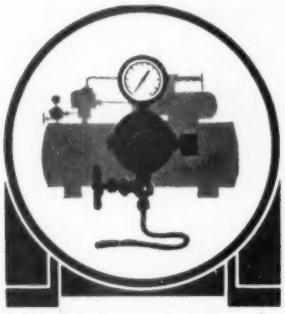
ENCLOSED SAFETY SWITCHES • SERVICE ENTRANCE EQUIPMENT • BRANCH CIRCUIT PANELS



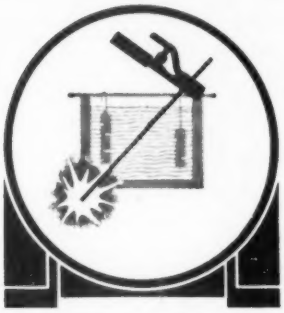
Refrigeration & Air Conditioning



Electrical Generation



Air Compressing



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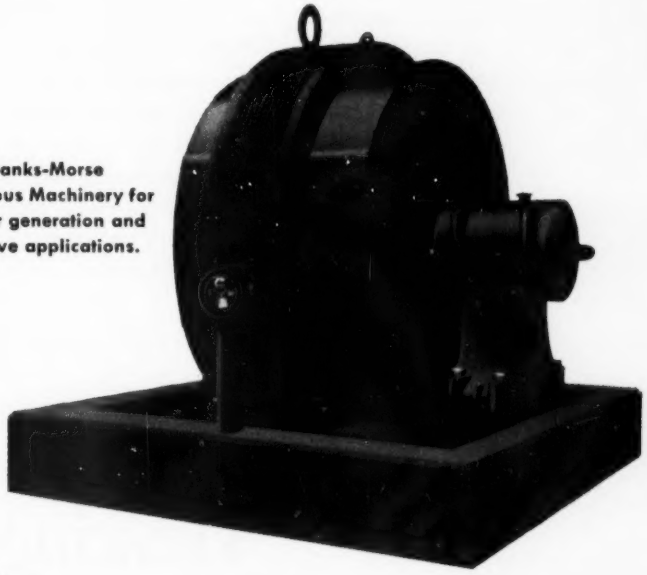
for every industry

When you need electric motors . . . in any rating, or frame type . . . one or a thousand . . . *always* look for the Fairbanks-Morse Seal. For over 120 years it has stood for the finest in manufacturing integrity to *all* industry.

Fairbanks, Morse & Co., Chicago 5, Illinois.

Fairbanks-Morse Synchronous Machinery for all power generation and large drive applications.



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Announcing

Westinghouse unconditional lighting fixture warranty

You name the terms . . . we'll back you up! This seal places an unconditional warranty as to workmanship and material on Westinghouse lighting fixtures for the life of your own installation guarantee.

A job well done deserves to be backed up, whatever the length of guarantee. Your guarantee expresses confidence in the quality of your work. That's why we go beyond the limits of the usual term guarantee. We believe in the quality of Westinghouse lighting fixtures. We'll match—with a warranty on our lighting fixtures—your installation guarantee to customers.

We feel there is no better way to demonstrate the lasting benefits of quality workmanship... quality materials. You can literally make a lighting installation and forget it. It's a powerful door-opener to sales opportunities up and down the block in every town.

Remember, this warranty applies to the commercial, industrial and floodlighting line of Westinghouse lighting fixtures regardless of price, style or type. You'll want to get complete details on this plan to build more business through satisfied customers. Register with Westinghouse and get your personal copy of the Warranty Book. Send in the coupon today. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-04327

YOU CAN BE SURE...IF IT'S

Westinghouse

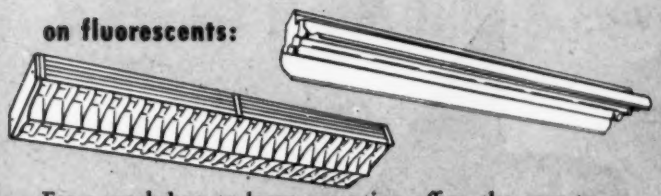
Warranty

LIGHTING FIXTURES

good for the life of your contractor's guarantee

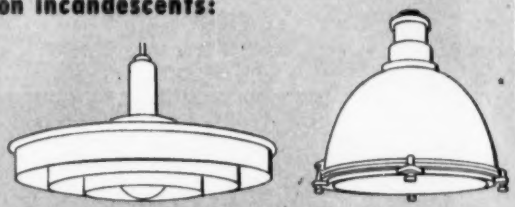
You install 'em we back you up

on fluorescents:



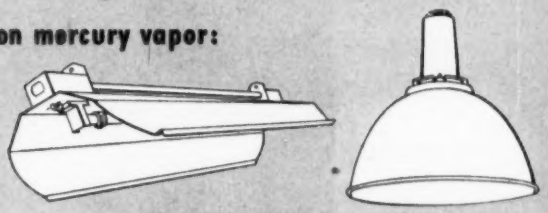
From workshop to large reception office, the easy to select and install Westinghouse fluorescents are built to last.

on incandescents:



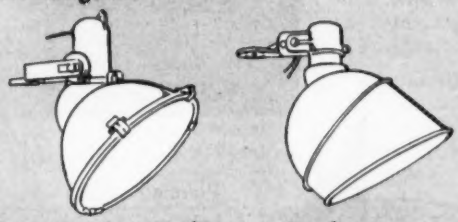
In clean or dirty locations, high or low bay areas, commercial or industrial buildings, Westinghouse incandescents fit every lighting need – with a long, outstanding service record.

on mercury vapor:



A complete line of fixtures – exclusive with Westinghouse – has zoomed to the front in industrial areas. They are easy to install – easy to maintain – designed to cut lighting costs.

on floodlights:



Built to weather outdoor service from construction projects to sports floodlighting jobs, Westinghouse floodlights are famous for ease of installation – dependable operation.

Sure – I want to know all about the new Westinghouse Lighting Fixture Warranty. Send me the simplified Selling Kit and Warranty Book.

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MY NAME_____ TITLE_____

ADDRESS_____

CITY_____ STATE_____

As fundamental as proper lighting...

No electrical contract is really complete unless it contains raceways for telephone wires.

Planned outlets—whether for lamps or telephones—help make the homes you wire more livable. Better looking, too, in the case of telephone outlets.

Builders will see an important sales feature in concealed telephone wiring. Owners will see convenience and protected beauty for walls and woodwork. You, in turn, will see extra profits coming from your house wiring contracts.

It's good business and profitable practice to include telephone raceways in every bid. Even if you make it an "extra."

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EASY TO INSTALL!

- **Convenient handling** . . . improved materials and compact design result in a small, lightweight transformer that can be easily handled.
- **Plenty of work space** . . . big, roomy wiring compartment for connecting system cables. Conduit knockouts are provided.
- **Fast hookup** . . . solderless clamp-type connectors that reduce hookup time to minutes are available on sizes 15 to 50 kva inclusive, single phase; sizes 45 to 112½ kva inclusive, three phase.

Get these benefits

All-welded case gives you complete protection. No additional enclosures or vaults are required. Surface finish is resistant to corrosion by acids, vapors, or moisture. Surface is Spra-Bonderized. Three coats of alkyd-resinous paint are then separately baked on.

Let Allis-Chalmers Class "B" dry-type transformers furnish full voltage at the load. To get complete information, contact your nearby Allis-Chalmers district office or write — Allis-Chalmers, Milwaukee 1, Wis.

A-4033

DESIGN ARRANGEMENTS

KVA SIZES		MOUNTING ARRANGEMENT	TERMINATIONS
SINGLE PHASE	THREE PHASE		
3 5 10	9 15	WALL MOUNTING LUGS	BOTTOM TERMINAL COMPARTMENT WITH REMOVABLE FRONT PLATE
15 25	30	WALL MOUNTING LUGS AND BASE FOR PLATFORM MOUNTING	TOP TERMINAL COMPARTMENT WITH REMOVABLE COVER
37½ 50 75 100 167	75 112½ 150 225 300	BASE FOR PLATFORM MOUNTING	TOP TERMINAL COMPARTMENT WITH REMOVABLE COVER

ALLIS-CHALMERS

INSTALLATION: Society for Savings, Barry Square Branch, Hartford, Connecticut.
ELECTRICAL CONTRACTOR: T. J. Martin Electric Co., Hartford, Connecticut.
ARCHITECT: Sherwood Jeter in collaboration with Hartford Electric Light Co.

FIXTURES: Litecontrol No. 5924 and 5928, 2 lamp slimline recessed troffer, 4 feet and 8 feet long, using No. 9015 Holophane lens. Also No. 6FH recessed lens boxes in Reception Area, and for accent.
SPACING: 7'-0" on centers.
CEILING HEIGHT: 10' approximately.
INTENSITY: 50 Footcandles average in service, over work area.

What Makes the LIGHT Right Here?

Three things — good layout, light floor and wall coloring, and efficient lighting by LITECONTROL.

Note the interior of this bank is clean, simple, inviting. No old-fashioned glass partitions to pick up bright reflections. No clutter of desk lamps or other supplementary fixtures to cast shadows and complicate the lighting problem.

LITECONTROL recessed fixtures 5924 and 5928 blend smoothly into the ceiling. The eight-foot units assure high level illumination over the work areas. Smaller four-foot units assure adequate illumination over light-colored floors in public area.

Holophane Low Brightness Lenses throughout prevent eye-tiring glare or sharp contrasts.

Interesting high-lights in the reception room are LITECONTROL Recessed Lens Boxes.

For information on how to make your lighting installations easy on the eyes, consult your local LITECONTROL man. Or write to address below.

LITECONTROL *Fixtures*

KEEP UPKEEP DOWN

LITECONTROL CORPORATION, 36 Pleasant Street, Watertown 72, Massachusetts

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

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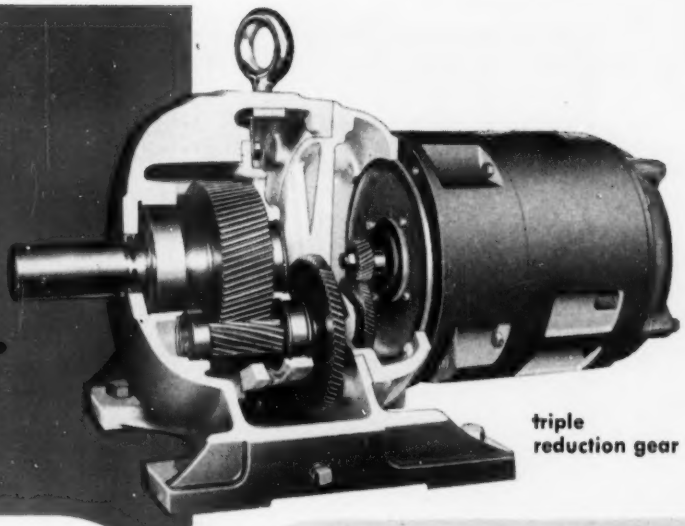


triple reduction gear

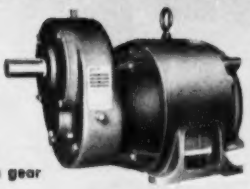
Here's

BUILT-IN SPEED... To Fit Your Need

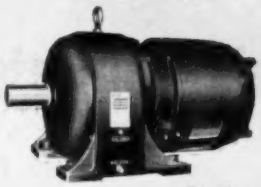
with a complete, new line of

Century Gearmotors

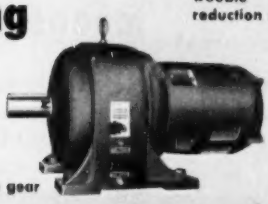
equipped with *Duti-Rated* Precision Gearing



Single reduction gear



Double reduction gear



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- **BUILT-IN SPEEDS**
- **MOTOR OPERATING CHARACTERISTICS**
- **FRAME PROTECTION**
- **HORSEPOWER RATINGS**... 1 to 15 h.p. with Duti-Rated Precision Gearing... and fractional gearmotors from ⅛ to ¾ h.p. are also available. Larger ratings can be furnished if required.

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☐ Bulletin 4-1p21 ⅛ to ¾ H.P.

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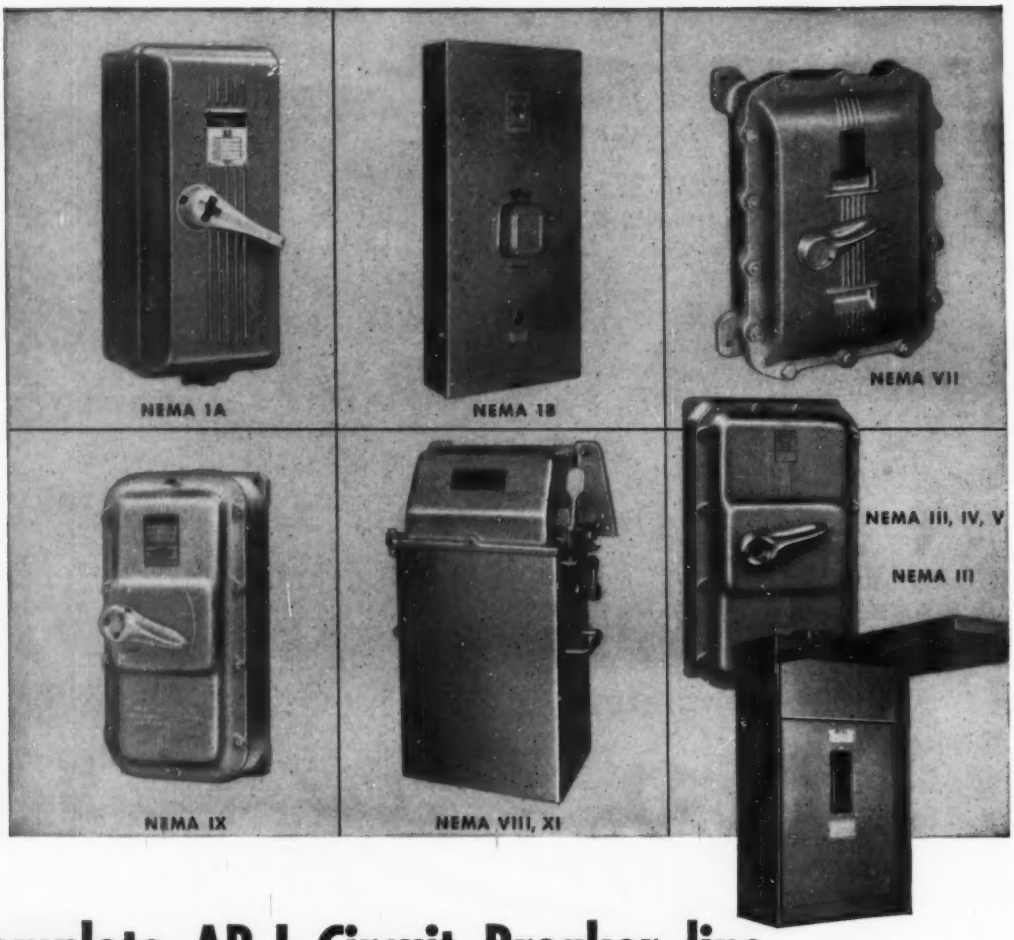
City ..... Zone ..... State .....



This complete AB-I Circuit Breaker line

solves more of your customers' problems— means more sales protection for you

Here's how to line up bigger circuit breaker sales—with the complete line of Westinghouse AB-I Circuit Breakers.

As shown above, there's an AB-I Breaker for *every* operating condition—indoors and outdoors, in wet and dusty locations, in explosive or corrosive vapors and dusts. Solving any application problem is merely a matter of selecting the right NEMA enclosure. Ends shopping around for "specials"—enables you to bid on jobs you couldn't handle formerly.

AB-I's solve many customer problems. They reduce downtime as much as 98%* compared with fused devices—eliminate dangerous fuse bridging, too. They save on maintenance—no replacement parts needed. They end unnecessary power outages with inverse-time-delay tripping action. And they protect workmen from live parts and costly accidents.

Certainly, AB-I Circuit Breakers can do a lot for your customers—and you! For complete information call your Westinghouse Representative or write for B-5456, Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pa.

**Name of company on request* J-30142

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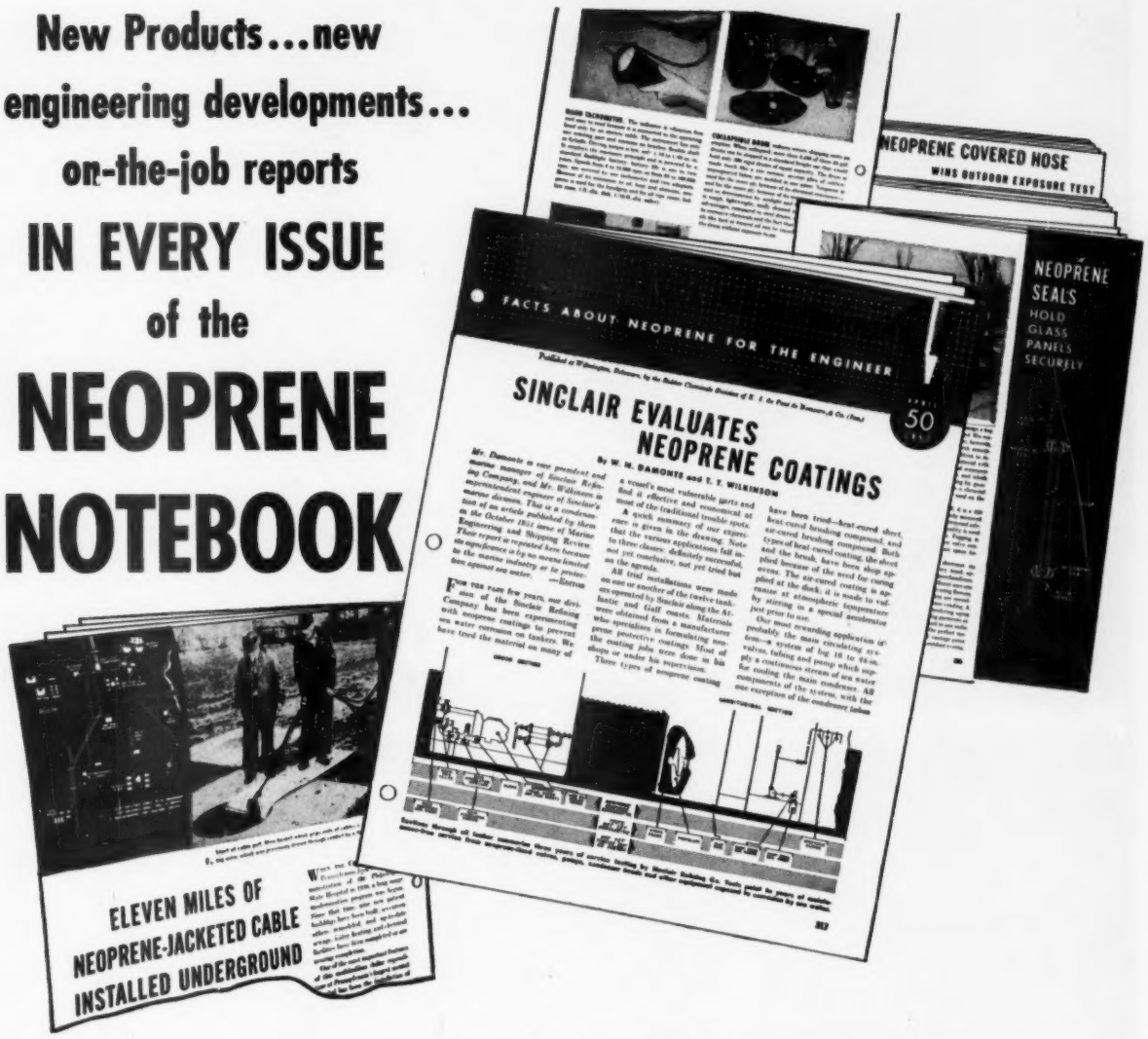
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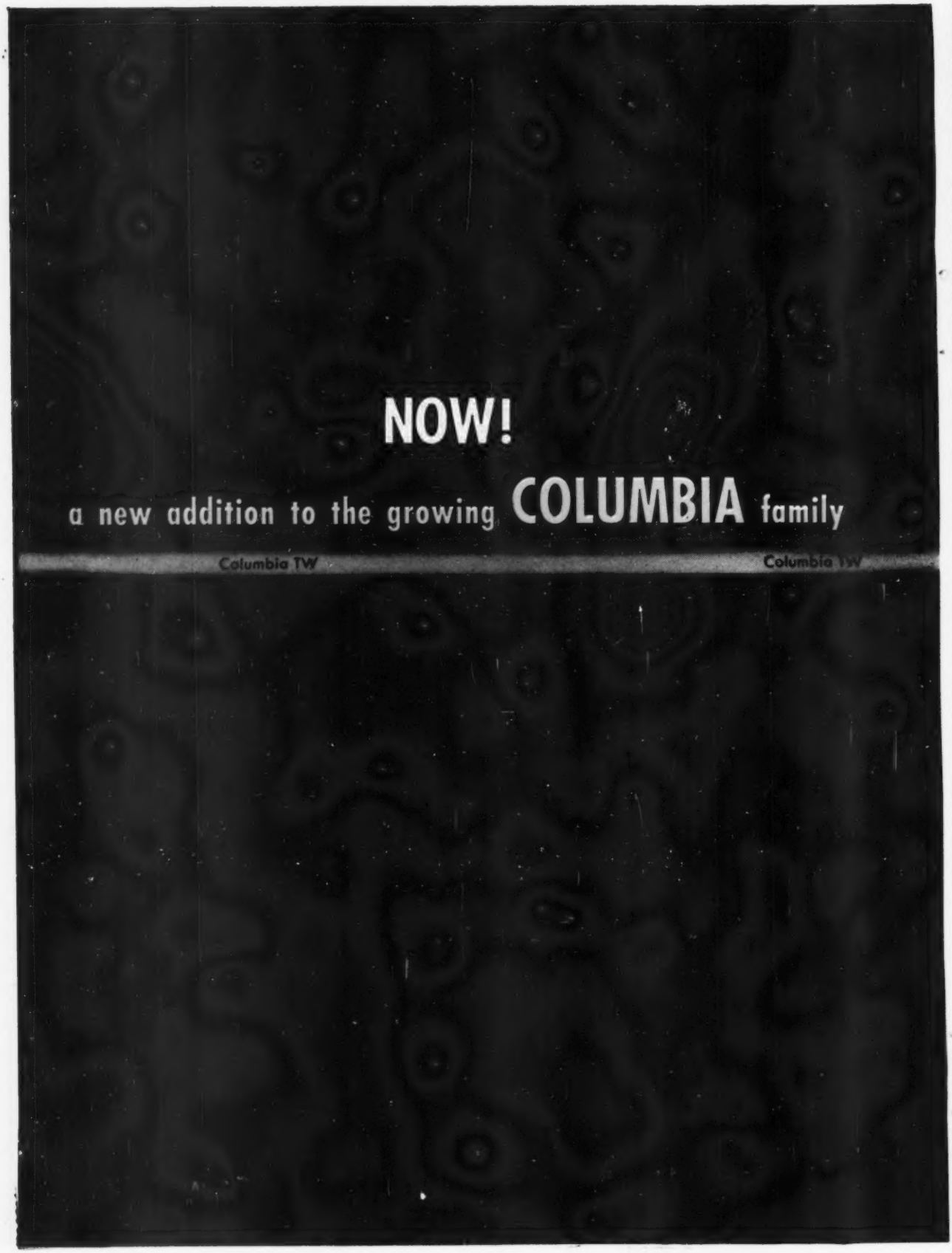
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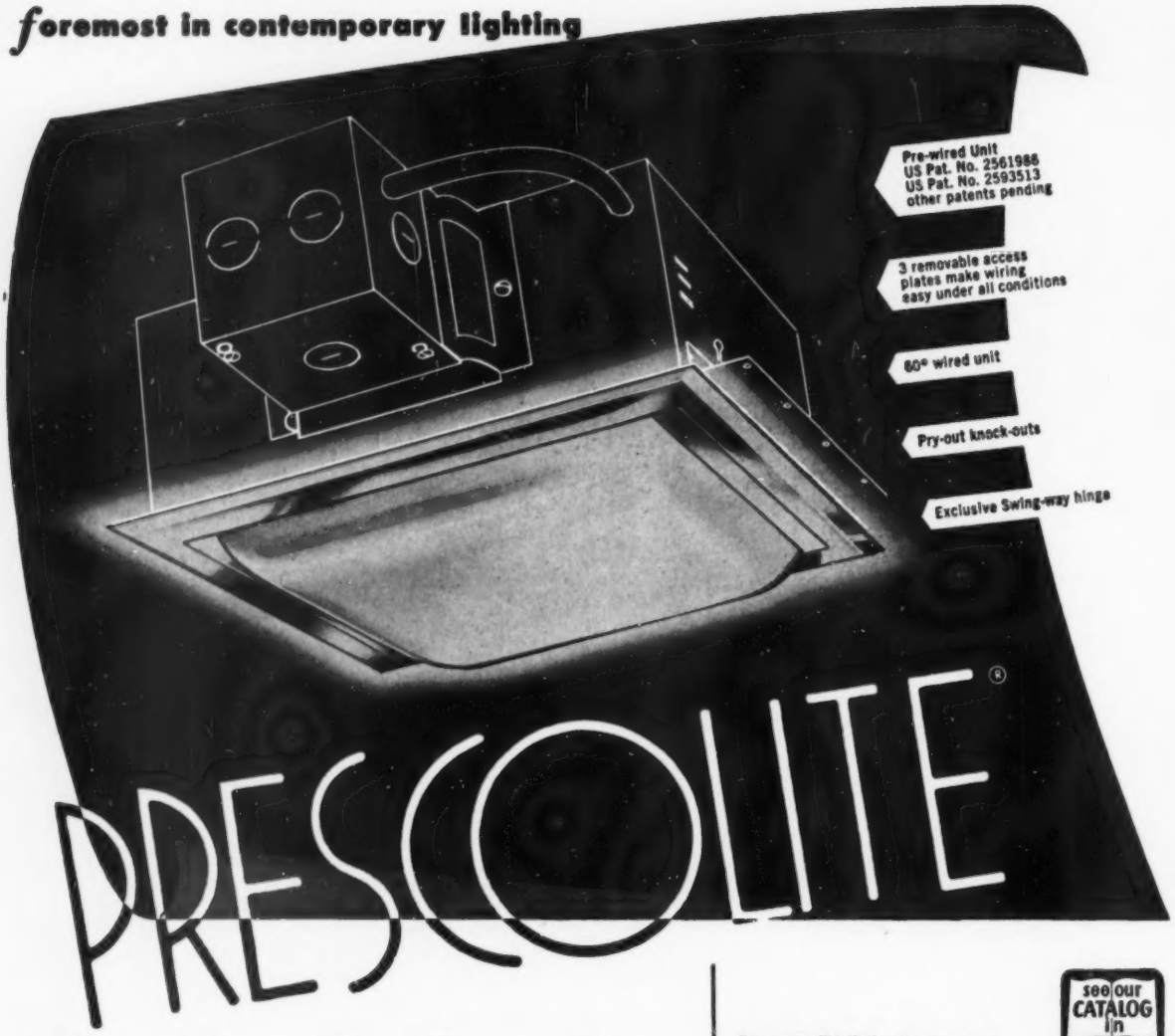

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Ramset Division, Olin Industries, Inc.

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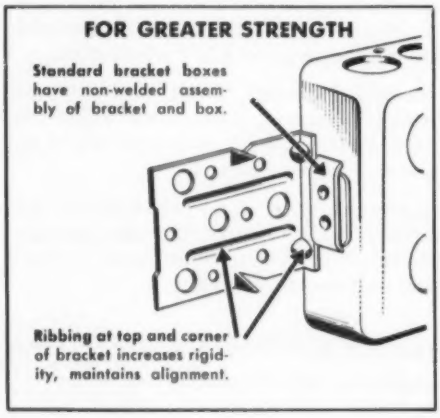
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Ribbing at top and corner of bracket increases rigidity, maintains alignment.

now available to meet your wiring requirements

With the recent addition of many new boxes, the G-E line of octagon, square, old-work, Levelock sectional device, and standard bracket boxes and covers now includes more than 170 types.

This complete line, including some boxes with and some boxes without cable clamps and plaster-mounting ears, makes it easy for you to select a box that exactly meets your wiring requirements.

It will pay you to investigate the complete line of G-E boxes and covers. Get full details from your G-E Construction Materials distributor, or write to Section C22-918, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

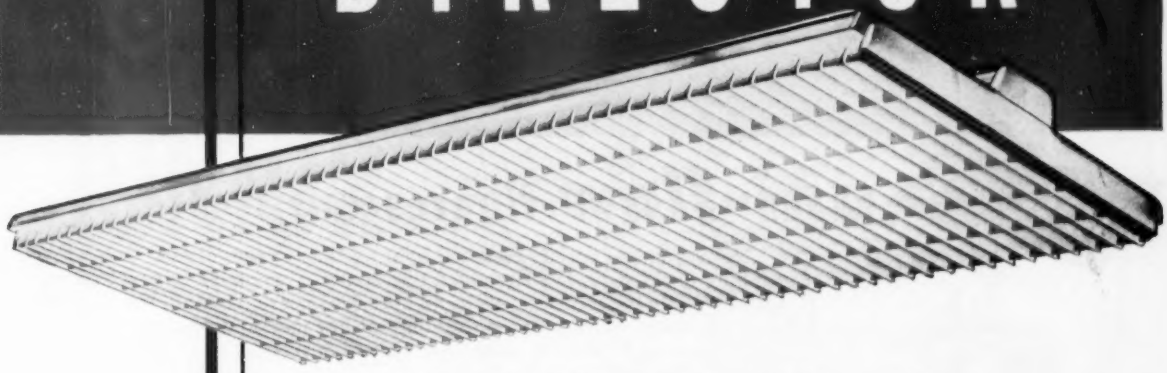
You can put your confidence in—

1878 75 1953 YEARS OF ELECTRICAL PROGRESS

GENERAL ELECTRIC

the thoroughbred of lighting that pays and pays!

THERE'S ONLY ONE Smithcraft DIRECTOR



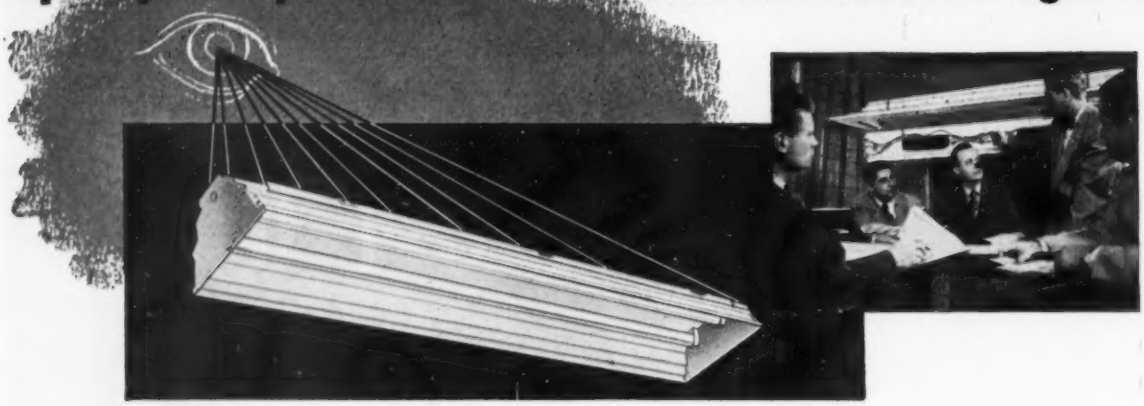
. . . a long-time lighting favorite that pays and pays. Pays owners and users in distinctive beauty and in superlative lighting characteristics. Pays contractors in excellent profits, in reputation . . . and in increased lighting business that a few outstanding Director installations will generate.

Where's the market for the Smithcraft Director. It's all around you! In stores, offices, schools, banks, public buildings . . . wherever you go. Show a man the difference between the lighting *investment* offered by the Director and an ordinary lighting *purchase*. He'll never settle for less. Make the Smithcraft Director *your lighting fixture* as thousands of contractors the country over have done. You'll be glad you did!

Ask us to send you our 8-page Smithcraft Director. The folder contains the results of comparative tests conducted by one of the nation's outstanding utilities . . . a leader in lighting.

Smithcraft
LIGHTING DIVISION
CHELSEA 50, MASSACHUSETTS

open your eyes to this revelation in recessed lighting



MITCHELL *uni-flow* fluorescent troffers

NOW you can specify recessed lighting that's years ahead of anything in the field. It's MITCHELL UNI-FLOW . . . completely new . . . dramatically different . . . easier to specify, easier to install, far superior in lighting efficiency. Architects, contractors, utility men and wholesalers say unanimously: *"This is what we've wanted in recessed lighting!"*

JUST 4 EASY STEPS TO A PERFECT *uni-flow* ONE MAN INSTALLATION

1 Uni-Hangers are roughly located in ceiling opening (no critical measuring required). Takes just minutes, regardless of ceiling construction. Saves hours of time on any job—cuts installation costs sharply.

2 Troffer shell (less ballasts, lampholders or reflectors) clamps to Uni-Hangers by means of special Uni-Liner clips (an easy one-man job). Simple screwdriver adjustment levels troffer properly.

3 Reflector-ballast-lampholder plate (the bulk of the total troffer weight) is attached to troffer shell by means of jack chains. Thus, there is no weight on the installer's hands when wiring.

4 With wiring completed, reflector-ballast-lampholder assembly attaches to troffer shell by means of exclusive "Perma-Latch" (no tools or extra loose parts required). Job is now ready for easy lamping.

HERE'S EVERYTHING YOU NEED FOR SIMPLIFIED RECESSED LIGHTING

Here is a complete family of matching troffers in every useful length. Units are available in 2-foot, 4-foot, 5-foot, 6-foot, 8-foot or 10-foot lengths, in deep (10″) or shallow (7″) types.

Here is the widest selection of shielding equipment: choice of Metal Louver, Plastic Louver, Alba-Lite, Prismatic Glass, Unilens, Twinlens, Curved Lens, Fota-lite, Longitudinal Shields and Crosswise Baffles.

UNI-FLOW troffers offer a choice of 40-watt T-12 standard or instant-start bi-pin lamps, 38-watt Slimline, 54-watt Slimline, 75-watt Slimline, 40-watt T-17 low brightness, 85-watt Krypton, 20-watt T-12 lamps.

Troffers are available with 1, 2 or 3 lamps (except 5-ft. and 10-ft. units with 1 or 2 lamps only). One-lamp units are available in choice of Alzak or baked white enamel reflector; two and three lamp units with baked white enamel reflector.

Only MITCHELL UNI-FLOW has these time-saving, cost-cutting features

Write, phone or wire today for the complete facts about MITCHELL UNI-FLOW
Address Dept., 2-J,

MITCHELL MANUFACTURING COMPANY
2525 N. Clybourn Ave., Chicago 14, Ill.
In Canada: Mitchell Mfg. Co., Ltd., 14 Waterman Ave., Toronto

THE MAKERS OF THE WORLD-FAMOUS AMPROBE NOW BRING YOU THE

NEW AMPROBE JUNIOR

VOLT-AMP TESTER

ACTUAL SIZE

$19.85

INCLUDING VOLTAGE TEST LEADS

One pocket tester does the complete job

IT'S A SNAP-AROUND AMMETER

Measures current instantly without shutdowns or breaking of insulation for ammeter connections.

IT'S A VOLTAGE METER

Measures voltage quickly, accurately on a full-sized calibrated scale; eliminates guesswork.

Gives you tester ruggedness with instrument accuracy (within ± 3% of full scale)

PICK THE RANGE THAT FITS THE JOB:

MODEL "10": 0- 10 AMPS A-C 0-125/250 VOLTS A-C
MODEL "25": 0- 25 AMPS A-C 0-125/250 VOLTS A-C
MODEL "50": 0- 50 AMPS A-C 0-125/250 VOLTS A-C
MODEL "100": 0-100 AMPS A-C 0-125/250 VOLTS A-C

Now every electrical man can be equipped with a snap-around volt-ammeter. The Amprobe Junior is similar to the world-famous Amprobe, except that it is built to fit a specific job at low cost. For only a few dollars more than just a voltage tester, you get an *accurate* voltage meter *and* a prized snap-around ammeter. Pays for itself the first month alone by eliminating guesswork and time-wasting connections. Write today for Catalog No. 132. Pyramid Instrument Corp., Lynbrook, N. Y. (Export Div.: 458 Broadway, N. Y. 13. Cable: Morhanex).

IF YOUR JOB CALLS FOR A MULTI-RANGE AMPROBE:

AMPROBE "300"

0-6/15/30/60/150/300 AMPS AC.
0-150/300/600 VOLTS AC.
$49.50 COMPLETE WITH LEATHER CASE AND VOLTAGE TEST LEADS.

AMPROBE "600"

0-15/30/60/150/300/600 AMPS AC.
0-150/300/600 VOLTS AC.
$59.50 COMPLETE

AMPROBE "1200"

0-15/60/150/300/600/1200 AMPS AC.
0-150/300/600 VOLTS AC.
$67.50 COMPLETE

KEYSTONE INSULATORS for INDUSTRY

CONTACT RAIL (TYPE BMS)

"SERVICE-ENGINEERED"

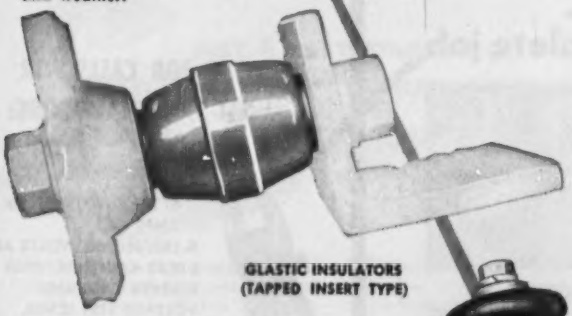
FOR UNFAILING PROTECTION ON THE TOUGHEST JOBS!

For longer, stronger life and peak protection, there's a Keystone Industrial Insulator that's "service-engineered" to meet every need. Let ESM engineers help you select the right mechanical and electrical qualities to solve your insulator problems. Call on them soon.

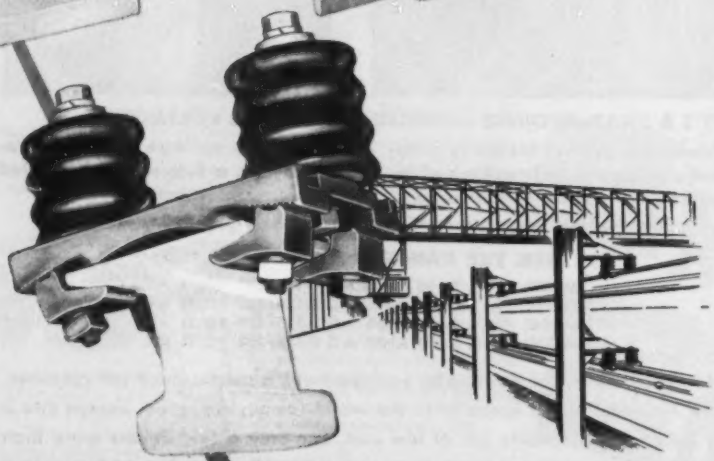
MOULDED GLASTIC INSULATORS

Fibreglass reinforcement and superior compounds provide maximum impact strength with excellent resistance to arc track, chemicals, heat and weather.

SUSPENSION INSULATORS

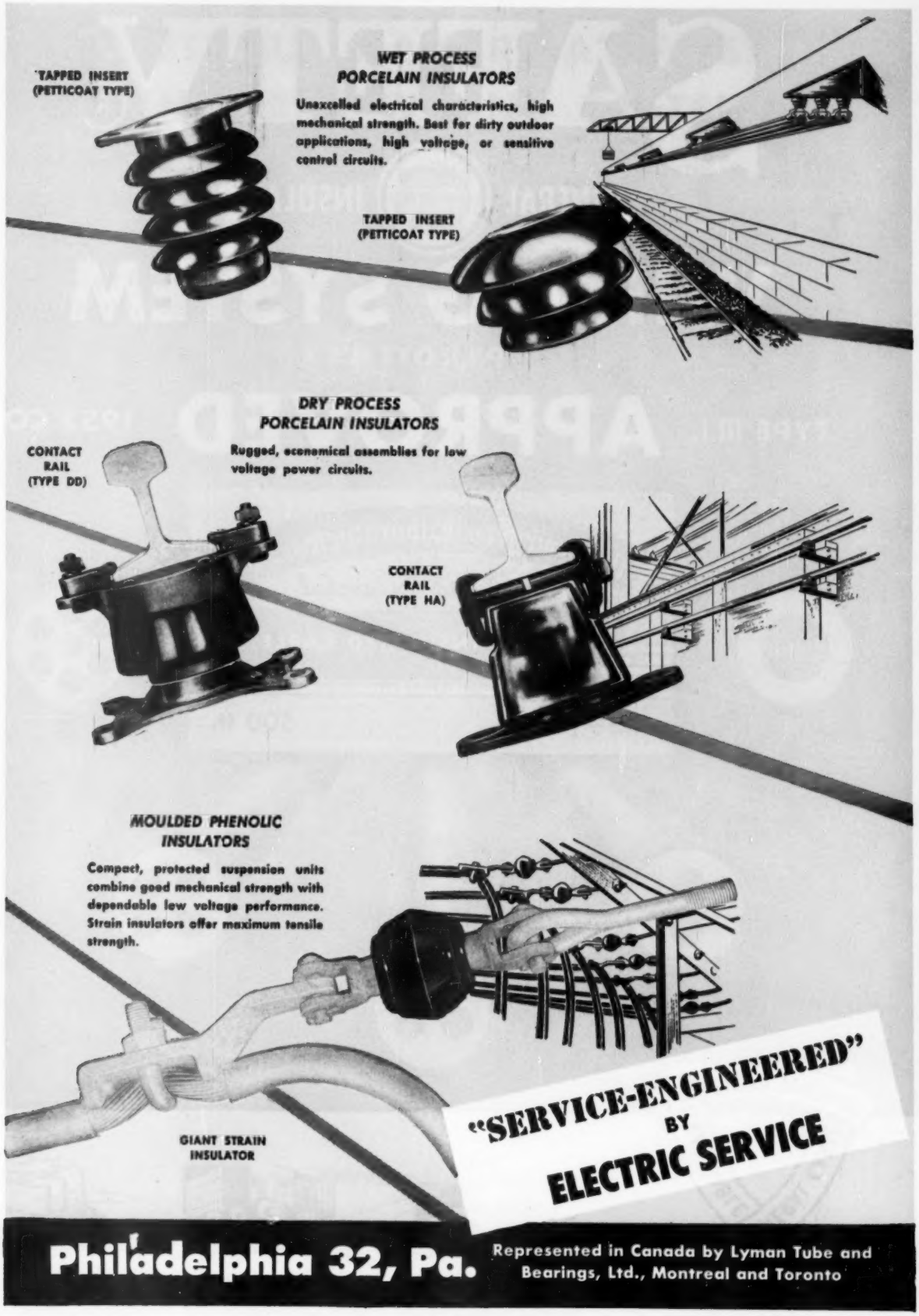


GLASTIC INSULATORS (TAPPED INSERT TYPE)



Basic units shown have great variety of application by use of proper fittings, selected from our Industrial Catalog. Write for illustrated folder.

ELECTRIC SERVICE MANUFACTURING CO.


TAPPED INSERT (PETTICOAT TYPE)
WET PROCESS PORCELAIN INSULATORS
Unexcelled electrical characteristics, high mechanical strength. Best for dirty outdoor applications, high voltage, or sensitive control circuits.
TAPPED INSERT (PETTICOAT TYPE)
DRY PROCESS PORCELAIN INSULATORS
CONTACT RAIL (TYPE DD)
Rugged, economical assemblies for low voltage power circuits.
CONTACT RAIL (TYPE HA)
MOULDED PHENOLIC INSULATORS
Compact, protected suspension units combine good mechanical strength with dependable low voltage performance. Strain insulators offer maximum tensile strength.
GIANT STRAIN INSULATOR
"SERVICE-ENGINEERED" BY ELECTRIC SERVICE
Philadelphia 32, Pa.
Represented in Canada by Lyman Tube and Bearings, Ltd., Montreal and Toronto

SAFETY®

MINERAL m.i. INSULATED

WIRING SYSTEM

PYROTENAX

TYPE m.i. **APPROVED** 1953 CODE

GENERAL CABLE

Good News for Architects

Safety m.i. Wiring System will give you new freedom in the planning of wiring layouts. Get the facts today.

CONSTRUCTION INDUSTRY

Economical for inside and outside wiring of commercial and factory buildings, theaters, garages... cranes, hoists... control, lighting and signal circuits.

GENERAL INDUSTRY

Lower installed costs, saves space as low voltage power feeders, lighting and control cables . . . for machine tools, and in most any location.

UTILITIES

Safety m.i. assures fullest safety on power and control installations... wherever problems of heat, moisture and aging must be met.

SAFETY m.i. IS AMERICA'S FIRST PERMANENT WIRING SYSTEM*

A Safety Mineral Insulated Wiring System will outlast all other wiring. It is moisture-proof, rigid yet flexible and unaffected by heat, cold, vapor.

Besides saving space (Safety m.i. is its own conduit), it has unique flexibility, trains to any contour, and cuts installation costs.

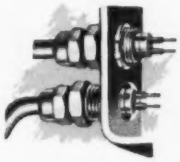
Ideal for dry or wet locations, for under-plaster extensions and embedded in plaster, masonry, concrete or fill . . . for underground runs and where exposed directly to weather, continuous moisture, oil, gasoline, etc.

Safety m.i. Wiring is adaptable to all low-voltage applications, fits all standard switch and junction boxes.

ONLY SAFETY m.i. WIRING SYSTEM (Pyrotenax®) *HAS THESE SIX REVOLUTIONARY ADVANTAGES*

WILL OUTLAST BUILDING IN WHICH IT IS INSTALLED!

Immune to age-deterioration due to its "all mineral" construction. Unaffected by high temperatures resulting from current overloads, either accidentally imposed or to meet emergency increased power demands.



ONE-STEP INSTALLATION!

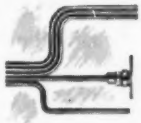
No additional mechanical protection required. Safety m.i. Wiring is its own conduit, installed in one operation with standard switch and junction boxes. Smaller diameter saves space.

NO VAPOR PASSAGE!

Completely filled with compacted mineral insulation. No need for specially installed seals in the cable run normally required to prevent passage of combustible gases through a wiring system.

COMPLETELY MOISTURE-PROOF!

Simple fittings permanently seal both ends of each run of wiring. No possible entrance for moisture. Normal concern over this hazard is, thereby, completely eliminated.



RIGID YET FLEXIBLE!

Thumb pressure bending is sufficient, in ordinary sizes, to fashion orderly wall patterns — or to conform wiring to any contour. Once formed, it rigidly stays put indefinitely when fastened with standard clamps or straps.

NO HEAT DETERIORATION!

The mineral insulation of Safety m.i. is physically stable up to 2800°C., thereby assuring against deterioration by heat even beyond the melting point of the copper sheath.

for complete information see your nearest General Cable Office, or write direct

"More Power to You"®

GENERAL CABLE

CORPORATION

Executive Offices: 420 Lexington Ave., New York 17, N. Y. Sales Offices in Principal Cities of the United States.

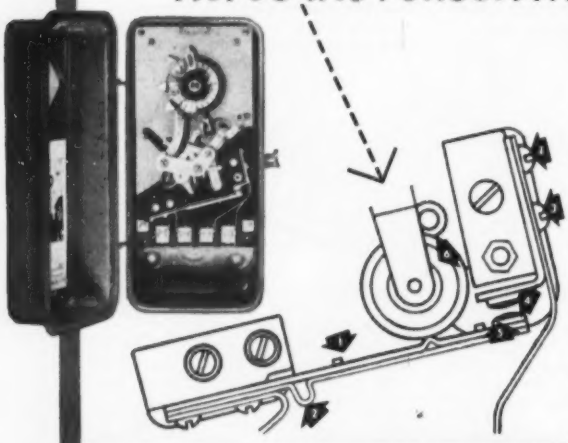
**Safety m.i. (Pyrotenax)® is exclusive with General Cable.*

for time switch quality *you'll never do better* than to choose Sangamo

When the chips are down—when you need a time switch that's *got to be good*—choose a SANGAMO . . . you'll never do better.

Why? Because Sangamo Time Switches were never built to merely meet minimum requirements. Sangamo Heavy Duty Time Switches have the exclusive Sangamo-built, slow speed motor that is quiet—needs no replacement, no repair, no oiling—that has the ability to keep operating under great temperature variations (from 50° below zero to 200° above!)—and that guarantees long life.

But the motor is only one of the reasons for the Sangamo reputation for quality.



here's the reason . . . for exceptional long contact life:

1. Spring member for maintaining proper contact pressure.
2. Flexible copper conductor for high current carrying capacity.
3. Stationary contact adjustment screws for easy setting of gap.
4. Heavy silver contacts for low-resistance and long life.
5. Curved contact surface for central point of contact when closed, and small gap when open—for minimum damage from arcing.
6. Roller for low-friction contact operation.

* Your electrical wholesaler can furnish all types of *dependable* Sangamo Time Switches. See them before you specify the time control for your next installation. Bulletin 1010 tells the full story—write today.

for your most exacting installations

SANGAMO
ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

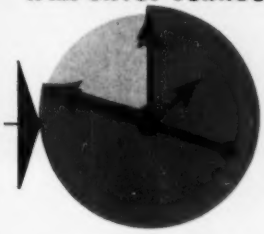
ST53-2

You can always rely on RACO

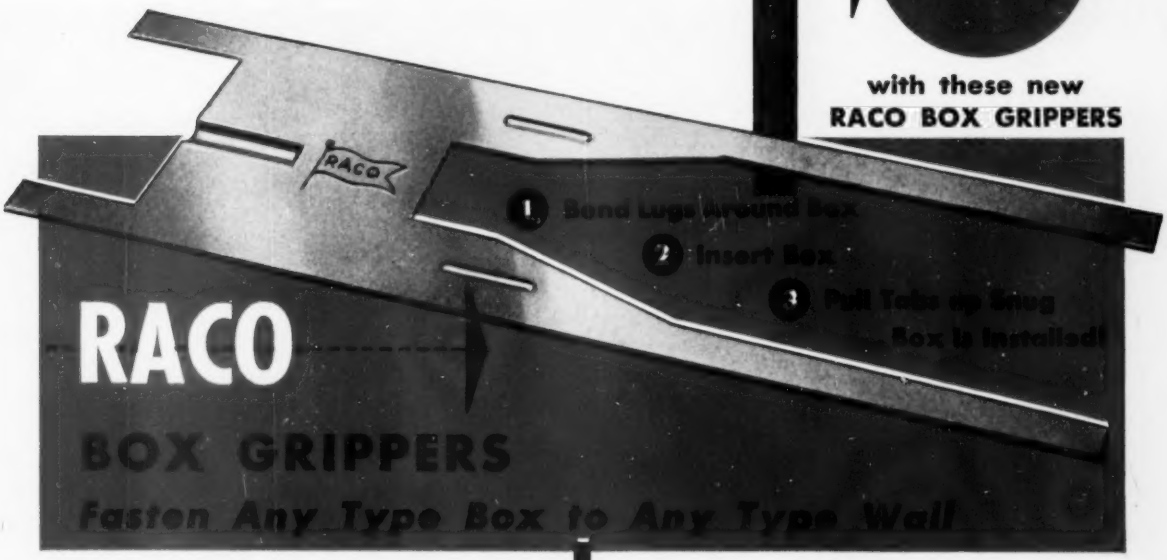
Save Time! Save Money!

INSTALL A RACO BOX IN 47 SECONDS

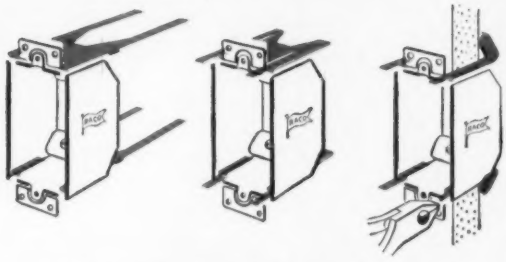
See Grippers Installed at Booth 51 IAEI Silver Jubilee



with these new RACO BOX GRIPPERS

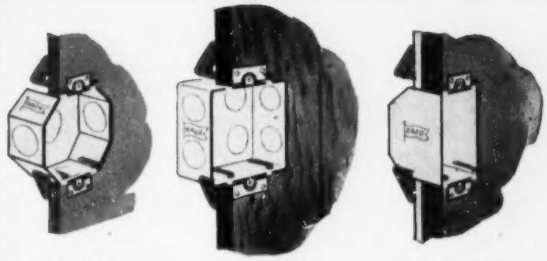


HERE IS HOW IT WORKS

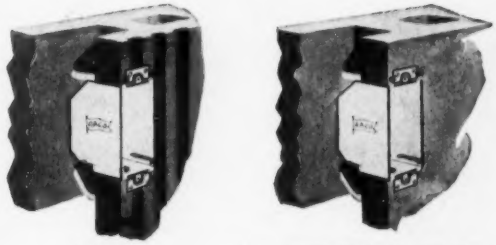


YOUR MEN WILL LIKE RACO BOX GRIPPERS

Raco Grippers are so easy to use! Just lay gripper on box . . . bend lugs over end of box and bend tabs forward. Insert box. Pull tabs up snug. Box is solidly and permanently fastened to any type of wall! Use Raco Box Grippers on any single or multiple wall box.



WALLBOARD WOOD PLASTER



TILE CONCRETE BLOCK

WRITE TODAY—Get Complete Information on RACO Box Grippers

"A BOX FOR EVERY NEED"

ALL-STEEL EQUIPMENT INC. • Aurora, Illinois

With G-E vertical lift, you can see when the breaker disconnects

Maximum safety to operator and equipment is provided. Mechanically operated shutters of insulating material close off disconnect openings when breaker is lowered. Stationary contacts are never exposed, present no safety hazard. Shutters open as breaker is raised, permitting entrance of breaker studs.

On G-E Metal-clad Switchgear—

1876 75 1951 YEARS OF ELECTRICAL PROGRESS

New safer, fast-action elevating mechanism can raise or lower breaker in 30 seconds

Vertical-lift design isolates breaker, simplifies inspection

Smooth, practically effortless raising or lowering of the breaker in General Electric's improved metal-clad switchgear, whether for inspection or test . . .

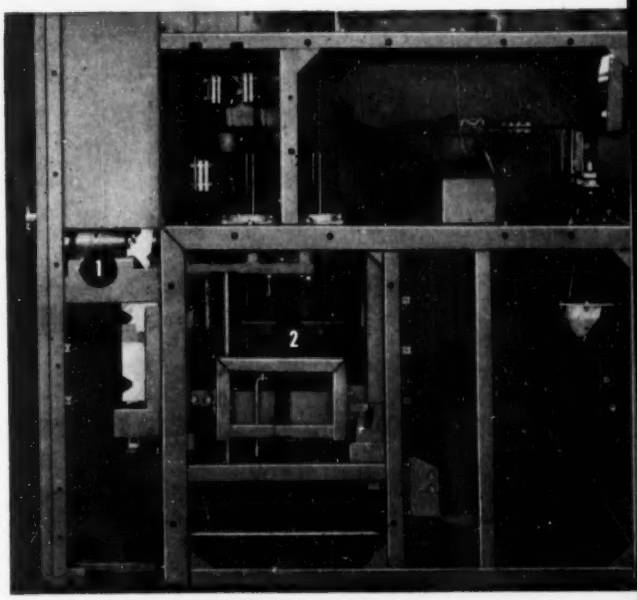
That is what you get with one of the simplest elevating mechanisms possible for the job: two jack screws—a sturdy cross chain drive—a compact gear motor with operating switches.

POSITIVE-ACTING MECHANICAL INTERLOCKS assure speedier operation. An interlocking system effectively blocks raising or lowering a "closed" breaker. In the operating position, the circuit breaker is locked in, preventing downward movement caused by even the most severe vibration. All parts of the elevating mechanism are accessible at front of the compartment, with the motor easily demountable for hand-crank operation.

BESIDES THESE ADVANTAGES of the new, faster-acting breaker-elevating mechanism, you also get full benefits of G.E.'s basic vertical-lift design. You can—

- See when breaker is isolated and breaker studs separated from main stationary contacts. Mechanically operated shutters close off disconnect openings to protect operator.
- Close the door with breaker in lowered position.
- Make most inspections and tests with breaker just lowered—not removed from compartment.
- Save time and energy, as mechanical lift makes removal of breakers convenient and easy.
- Gain quick, easy access to breakers in outdoor installations—especially on roofs where catwalks make other types of breaker removal inconvenient.

FOR THE COMPLETE STORY on G-E Vertical-lift Metal-clad switchgear, with ratings up to 13.8 kv, 500 mva, write for GEA-5664-A, Sect. 874-4, General Electric Company, Schenectady 5, N. Y.



NEW ELEVATING MECHANISM is shown in breaker with side plates removed. Compact gear-motor (1) in front of the compartment drives simplified jack screw mechanism (2) to raise breaker.

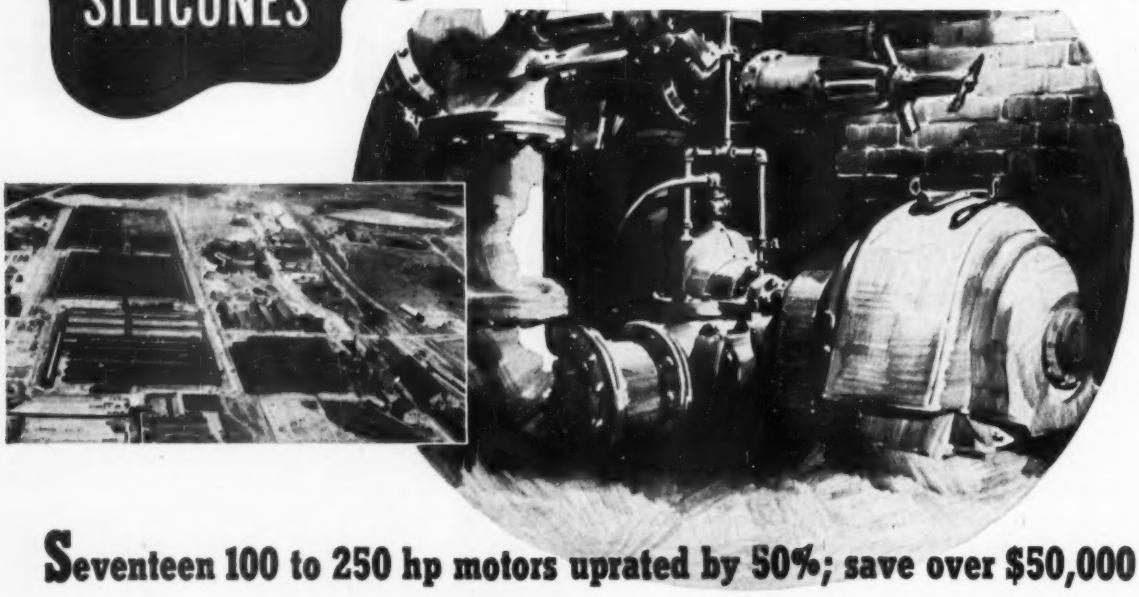
VERTICAL-LIFT DESIGN proves invaluable in outdoor switchgear installations—enables personnel to disconnect and inspect breakers easily in spite of gravel or other obstacles.

You can put your confidence in—

GENERAL ELECTRIC

DOW CORNING SILICONES

give motors more muscles



Seventeen 100 to 250 hp motors uprated by 50%; save over $50,000

Largest aluminum producing plant in the world, the Arvida Works of the Aluminum Company of Canada, Ltd., (Alcan) increased its capacity several times in the past few years to a current high of 2 million pounds of ingot per day. Over a year ago an obstacle to further expansion turned up in the ore plant, where bauxite is mixed with a caustic solution to separate the alumina. Called on to handle larger quantities of caustic solution, the plant was unable to replace their existing pump motors with larger motors. There was simply no room for them.

Alcan maintenance engineers neatly solved that problem by rewinding all 17 of their 100, 125 and 250 hp motors with Class H insulation made with Dow Corning silicones. Total power output was increased by more than 50%. The cost of rewinding with Class H materials was $50,000 less than the list price of the equivalent capacity in new motors. And that doesn't include the far greater expense of installing larger pedestals, changing all the fittings, and rearranging the pump lines to accommodate larger motors. Furthermore, downtime was held to a minimum during the changeover.

Rewound with Class H insulation these motors have carried a 50% overload for over a year in spite of frequent spraying with caustic solution. And that's typical of the performance of Class H motors, regardless of size. They can carry heavy sustained overloads; operate with greater power efficiency where periodic overloads are involved; give 10 or more times the life of Class B motors under comparable service conditions. That's why alert management, maintenance and production men now specify Class H insulation for hard-working motors, generators and transformers.

mail this coupon today

Dow Corning Corporation
Dept. G-9, Midland, Michigan
Please send me:

- ☐ Performance Data on Class H machines.
- ☐ List of Class H motor repair shops.
- ☐ Data on Silicone Grease for motor bearings.
- ☐ 24 page booklet entitled "Tall Tales and Fabulous Facts."

Name_____

Company_____

Street_____

City_____ Zone_____ State_____

You can also reduce or eliminate motor outages due to bearing failure; specify Dow Corning 44 Silicone Grease for motor bearings.

In open and single shielded bearings designed for high temperature operation, Dow Corning 44 has 8 to 10 times the life expectancy of conventional greases. It gives life-time lubrication in permanently sealed bearings.

DOW CORNING CORPORATION
Midland Michigan

DOW CORNING SILICONES

ATLANTA • CHICAGO • CLEVELAND • DALLAS • DETROIT • LOS ANGELES • NEW YORK • WASHINGTON, D. C. (Silver Spring, Md.)

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ANACONDA FORUM
for the Electrical Industry

MODERNIZATION AND ELECTRIFICATION— A LOOK AHEAD

by: Maxwell Cole
Manager Market Studies and Service Division
Philadelphia Electric Company
Philadelphia, Pa.

AMERICAN industry, its vision of new products for better living, its ingenuity in developing new methods and materials to make them, and its courage to invest in the facilities to produce them is the cornerstone on which American living standards have been erected. To make more things, faster, better and cheaper so that they may be available to more and more people has been the goal of American industry. Its success in reaching toward that goal has been its outstanding accomplishment.

REPLACING MANPOWER WITH HORSEPOWER

Operating in a free competitive economy, at liberty to develop new products and better ways of making them, American industry has taken full advantage of the opportunities offered by modern, high speed tools powered by electricity to increase its productive capacity, to improve its product and to reduce costs by replacing manpower with horsepower. Refrigerators and washing machines, automobiles and jet-propelled planes, plastics and stainless steel and many other of today's conveniences, even necessities, would not be available in sufficient quantity or at low enough prices to have become accepted elements of American life but for the readiness of industry to accept new products and new methods and to modernize their facilities to accommodate them. Industry's readiness to streamline production methods and modernize facilities enabled us to snow our enemies of World War II under an avalanche of production.

NEW CHALLENGES

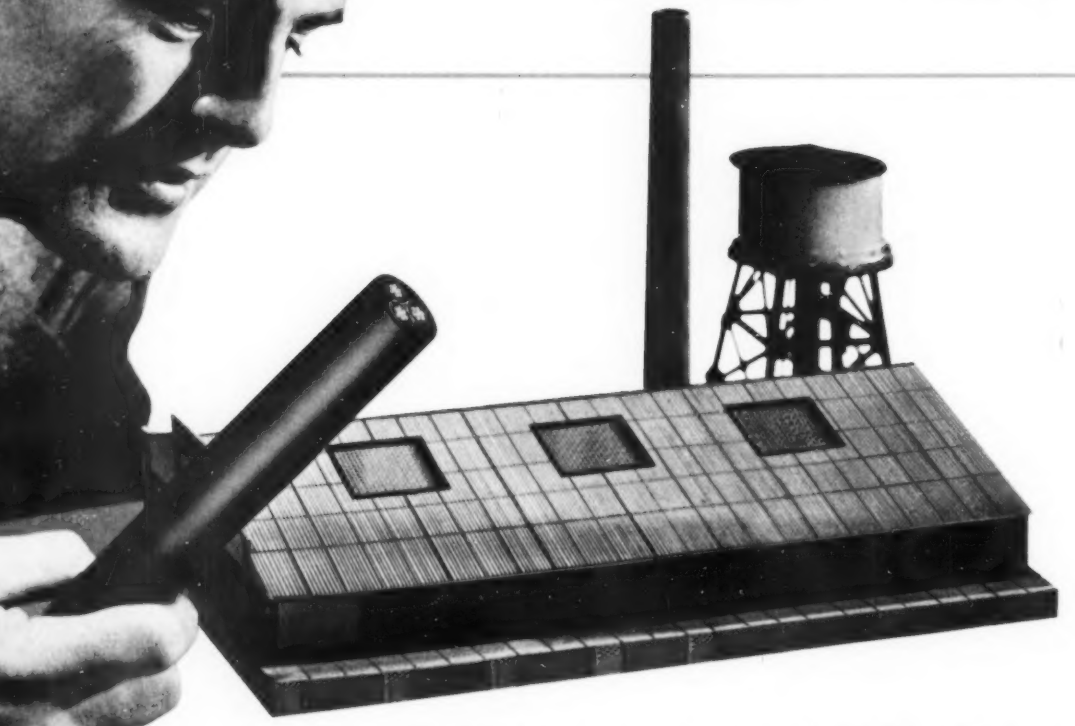
Today, industry faces new challenges. It must produce materials of war in such quantity and of such quality that no enemy dare attack us; it must maintain progress in fields of civilian production; and many people believe we are entering an era of keener competition than experienced for many years. Industry's ability to meet these challenges depends on its willingness to continue to modernize facilities and keep abreast of progress.

CONTINUED MODERNIZATION LIES AHEAD

We stand only on the threshold of the promises science and industry hold out for our future strides into security and better living. These promises will become realities only as better, more powerful tools are developed for producing them and as industry maintains its courage in investing in them to continue our national progress and replace wasteful or obsolete methods. Contemplating such a vista of promises, with faith that American industry still possesses characteristics which raised it to its present level of greatness, one foresees continued modernization of American factories, processes and products at a pace even greater than it has been in the past.

AMERICA'S CHALLENGE to industry is to meet and sustain an increasingly higher level of production in the face of keen competition. New and better equipment—such as this installation of a 75,000-pound chain drawbench in a Connecticut Mill—is a vital part of expansion and modernization. With each new machine comes the need for increased power and modern wire and cable!

A LOOK AT MODERN



It was great sport but . . .

EVER SEE A STUTZ "BEARCAT" on the road these days? With loving care and a knack for tinkering, hobbyists still keep a few going. They are good cars . . . but hardly economical modern transportation. Now consider how much antique wiring lies around still doing a job . . . of sorts. Hardly efficient. Pathetically unprofitable when pitted against modern power needs. What are we going to do about it? The following article gives some good reasons for re-evaluating our requirements for reserve capacity and replacing obsolete wiring . . . with new and better products.

ONCE MORE it's a case of growing pains! Today industry has already used up its power reserves—though these were considered adequate ten years ago. Now it's time for another upward revision of our ideas of what is a sufficient power margin for operating the new production tools that have been put in our hands. To power them, utilities are now in the process of re-doubling their load capacity. Our stepped-up rate of production and consumption has telescoped the future . . . even beyond the soberly considered estimates of industry leaders as recently as a decade ago!

The link between tool and power source is wiring. New tasks suggest new techniques . . . new tools . . . new power loads . . . new wiring to carry the load. Yesterday's wiring may bottleneck today's production flow.

Some existing plants haven't spotlighted their wiring in many a year. Now—with new production factors in the picture—it is time for a basic survey of wiring. If it's obsolete, replace it . . . and reap the benefits of more efficient power, greater reliability, and long-range economy.

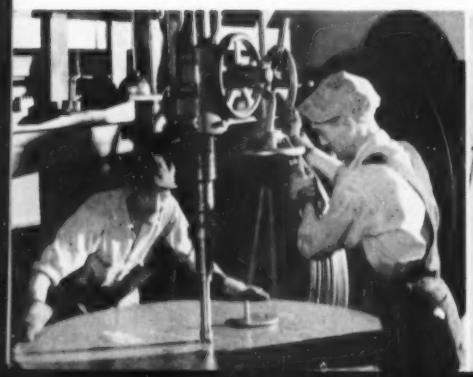
Modern wiring has seen a wealth of new developments—especially in insulation. Let's take a quick look at what's been done. It's all interesting, practical and valuable.

RUBBER INSULATION

Modern wiring may be defined as that approved and accepted since World War II. Twenty years ago we spoke of "enormous strides" in such things as rubber compounding. These resulted in superior products. We

ANACONDA was the first manufacturer of wire and cable to use synthetic resin compounds for insulation. One example is DENSHEATH*—a high-grade and super-aging thermoplastic (vinyl resin). This is widely used today for wiring on (1) machine tools, (2) appliances, and (3) various types of signal systems—as well as for control or switchboard, building or general purpose wiring.

*Reg. U.S. Pat. Off.



DEVELOPMENTS IN WIRING INSULATION

ARE WE ASKING OBSOLETE WIRING TO DO TODAY'S NEW JOBS?

can still speak of "progress." There has been lots of it. They are still striding forward—the chemists, metallurgists, cable engineers and their co-workers. The end is not in sight.

Heat is the great enemy of electrical insulation. But today Code Rubber, Type R, does a much better job in withstanding heat than a few years ago. TABLE I shows how this and other rubber compounds compare.

KIND OF INSULATION	MAXIMUM ALLOWABLE CONDUCTOR TEMPERATURE		
	1940	1947	1953
	degrees C		
Code, Type R	50	60	60
Type RW	50	60	60
Type RH	75	75	75
Type RH-RW	—	—	75,60**
Heat- and moisture-resistant	60,70,75	75,80	75,80
Ozone-resistant* (ASTM oil base)	70	70,75	70,75
Ozone-resistant* (butyl)	70,75	75,80	80,85

*Temperature varies with manufacturer
**whether in dry or moist location

TABLE I

Type RH-RW is outstanding. This is being used so much now—at little more cost than Type R—that the latter has a narrower market than even just after the war. Ozone-resistant, butyl-base compound is another excellent performer. Its stability, long aging, low power factor and other desirable physical and electrical properties under severe operating conditions make it a dependable compound for voltages up to 15 kv and sometimes higher. Several manufacturers supply it.

During World War II natural rubber was out. Synthetic (G-RS) rubber took its place. In just a few years, cable manufacturers found many things in its favor . . . so many, in fact, that the natural product is disappearing as a wire and cable insulation. "Cold" rubber is another development. Coming fast into regular use, it brings improved physical and electrical properties to low-voltage cables.

B-r-r-r . . . now I'm cold!

Another forward stride is the pre-war development and post-war application, in great quantity, of neoprene jacketing for rubber-insulated cable. Dependable under many severe conditions, relatively inexpensive, it is excellent in moist or dry conduit, direct burial, in aerial and other locations.

THERMOPLASTIC INSULATION

You can do a modern wiring job today with materials barely existing or unknown as late as just before World War II. These are the thermoplastics. Two stand out as basic insulations: polyvinyl chloride (vinyl resin and one or more of its co-polymers, which appear under various trade names) and polyethylene.

Polyethylene is a remarkable insulation for many purposes. It made radar possible. Now, however, the real workhorse of the industry is the first—PVC for short.

Millions of feet of PVC are used annually for wiring houses, stores, office buildings, by the armed forces and in many industrial applications. It resists many enemies of insulation: oil, moisture, acids, alkalies, abrasion, greases, and gasoline. With just normal treatment, it has a long life.

There are many other thermoplastics; the list has grown long in just a few years. But only a few others are used for insulations. Among them are Rulan, Nylon, Cardolite, Saran, Tenite II, Styraloy, and Teflon.

Polyethylene has a very high dielectric strength, low power factor and low moisture absorption when compared to vinyl resin. The latter has lower dielectric strength, high dielectric loss, and satisfactory moisture resistance. Vinyl resin resists ozone. Polyethylene is immune to it. This indicates why polyethylene can be used for high-voltage and high-frequency circuits while vinyl resin, which is cheaper, does very well on low voltages. Both have a weakness. They become plastic at comparatively low temperatures. High overloads on these types of conductors must be guarded against. TABLE II lists some comparative values.

Kind of Insulation	Code Type	Application	Maximum Allowable Conductor Temperature and Location (degrees C)
vinyl resin	T	general purpose	60 dry locations
vinyl resin	TW	general purpose	60 moist locations
vinyl resin	—	machine tool control and switchboard	60 in oil 80 in air
vinyl resin	—	appliance wiring	80,90, or 105 in air only*
Polyethylene	—	general purpose	80 usually special

*depending on compound used

TABLE II

"Thermoplastics help me reduce."

Logically thermoplastics replace rubber insulations for some applications—but not for all. In building wire one outstanding property of thermoplastics is toughness. They require no protective braid. Hence, wire so insulated takes less space.

* * *

This article provides only a brief sketch of a fascinating field. Lower operating costs from more efficient power distribution influence plant profits. In the light of developments discussed here, many readers may want to re-evaluate their own wiring. It's a timely undertaking. We suggest that for more details you write to, or consult with, individual manufacturers.

DURASHEATH* neoprene-jacketed cable has ANACONDA Type ANW (cold-rubber) or Type AB (ozone and heat-resistant butyl) insulation, depending on voltage rating. Used for (1) distribution networks and where wet ducts may contain acid or alkali waters, (2) industrial power distribution overhead, in direct burial, or conduit, (3) circuits in conduit—and many other applications.

*Reg. U.S. Pat. Off.

If you want to cut equipment-relocation costs . . .

WIRE MACHINES TO MAKE THEM MOVABLE

Basic industry strategy calls for more productive machine power. Look into plants like those of the automobile makers. There large banks of automatic machines are lined up in close array. They turn out parts. One bank may occupy only a small part of the long, huge floor area required.

MACHINES SOMETIMES MOVED

Each machine needs a cable. Offhand it seems easy to get cable to machine. But actually some ingenuity is needed to avoid excessive installation costs. The situation is aggravated by the chance that next year —or next month—all machines must be moved in accordance with model changes or plant efficiency.

BUS AND BUSDROP CABLE

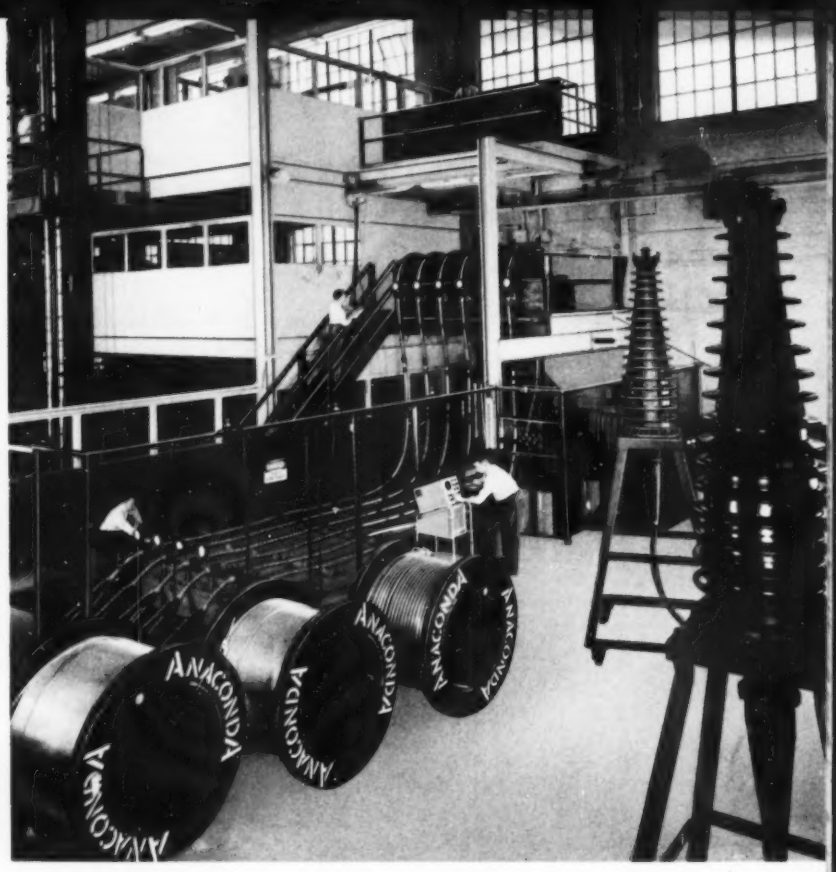
You can solve the whole problem very neatly. First install a busduct system on ceiling or under roof trusses. Then connect each machine to it with a flexible cable carrying power and grounding conductors. This cable is called "busdrop cable."

IT'S EASY to plug in your machine with flexible busdrop cable. There's no rigid conduit to rip out later.

TAILOR-MADE SYSTEM

Busduct Power Distribution Systems are widely used. They may be bought tailored to any plant's needs. They are economical; cable can be disconnected and reused elsewhere. This is done often. It means real flexibility, saves time and maintenance costs. It helps industry to keep up its high pace of production.

To do its job right, to last long and to stay neat, busdrop cable must be able to take heavy mechanical abuse and must handle easily. It must be impervious to oils, acids, water, greases, and cutting compounds. And, of course, it's always wise to look for approval from Underwriters' Laboratories, Inc. 53B94



LAB THAT HURRIES TIME

. . . CUTS YEARS TO MONTHS IN TESTS TO GIVE YOU LONGER-LASTING CABLES

In this Cyclic-Aging Laboratory at Hastings-on-Hudson, N. Y., high-voltage insulated cables race through the calendar. Once the valuable data which cable-aging made available to electrical engineers took decades to accumulate in actual service—often 20 to 50 years. But here a lifetime of experience is gained in a few years. Rigorous 24-hour test cycles simulate actual conditions . . . but are much more severe. Anaconda Engineers get vital data on cable life, stability and other characteristics needed to evaluate cable design.

This is typical of Anaconda planning—geared to the future. It is only a part, however, of a company-wide program of expansion and improvement now nearing completion in mills and mines. Net result: better cables, available in larger quantities, that last longer and give you *true* economy in use *when you specify* ANACONDA.

FOR FURTHER INFORMATION about any product mentioned in the pages of this advertisement, see your Anaconda Representative . . . or write to *Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.*

ANACONDA®

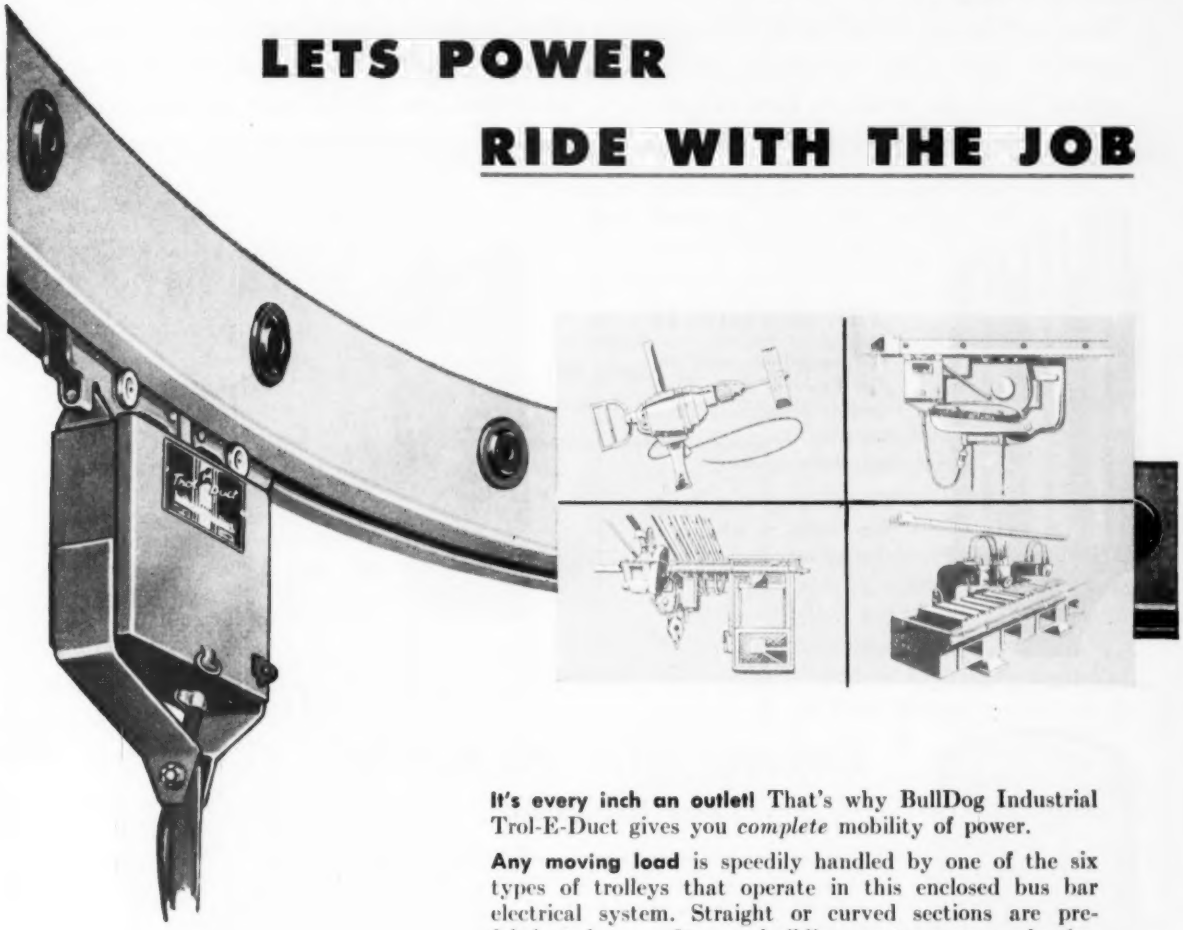
TODAY'S HEADQUARTERS FOR WIRE AND CABLE

MAKERS OF building, barn, machine tool, control and communication wire • service and overhead distribution cables, bare and weatherproof including ACSR • portable cords and cables • power and busdrop cables • mine, bridge, aerial, underground, duct, network and submarine cables • parkway, airport and street-lighting cables • station, apparatus and vertical-riser cables • magnet wire • copper, aluminum and copperweld conductors • wire and cable accessories.

BULLDOG INDUSTRIAL *Trol-E-Duct*

LETS POWER

RIDE WITH THE JOB



It's every inch an outlet! That's why BullDog Industrial Trol-E-Duct gives you *complete* mobility of power.

Any moving load is speedily handled by one of the six types of trolleys that operate in this enclosed bus bar electrical system. Straight or curved sections are prefabricated . . . fit any building contour or production line design.

Completely reusable, Industrial Trol-E-Duct brings you substantial production gains because it practically eliminates "downtime." Trolleys can be removed and replaced without current shut-down . . . no sagging wire conductors to halt production for maintenance. There's no more time wasted hunting for a free outlet . . . no more messy, dangerous extension cords.

Industrial Trol-E-Duct is another thoroughbred BullDog product designed to give you matchless economy with highest efficiency and flexibility. Write today for free Bulletin IT-655. BullDog Electric Products Company, Dept. EC-93, Detroit 32, Michigan. ©BEPCO

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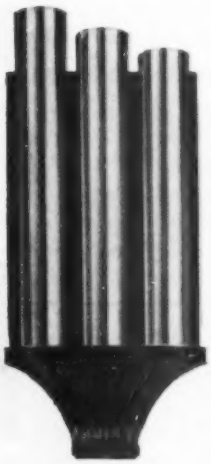
IAEI SILVER JUBILEE
EDGEWATER BEACH HOTEL
SEPTEMBER 21-26, 1953

BULLDOG
ELECTRIC PRODUCTS COMPANY

Let your watch decide!

Time an Edwards installation. Notice how quickly, how easily everything fits into place. That's no accident. Edwards products are designed to save you man hours.

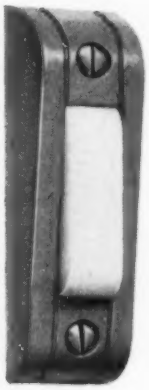
And, as thousands of users will tell you, they're designed for years of trouble-free operation, too. Build your reputation on quality — install Edwards equipment.



THE CHORDETTE

Soft, melodious, most popular Edwards door chime. Sounds continuous chord for front door, a two-note tune for rear door.

In mahogany with bright brass tubes or white with chrome tubes.



KEYNOTE PUSH BUTTON

Elegant slim design, piano key action. Harmonizes with any surroundings. In four brilliant colors and tones. Glowing brass, sparkling chrome, conservative chocolate brown, lustrous ivory—all permanent plastics that never need polishing. Mounts in moments . . . costs no more than ordinary buttons.

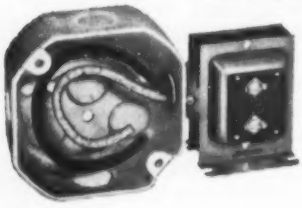
EDWARDS BELLS AND BUZZERS
For the Home

Inexpensive, attractive, simple to install. In satin aluminum finish with snap-on covers. Designed for 6 or 8 volts 60 cycle AC for transformer operation . . . 3 to 6 volts DC for battery operation. Over 10 million of these bells and buzzers have been installed in homes and industry all over the world.

DIXIE BELL—Completely enclosed. May be installed with exposed wiring.

NUBEL—Exposed gong, enclosed binding posts and mechanism.

EASI-MOUNT TRANSFORMER



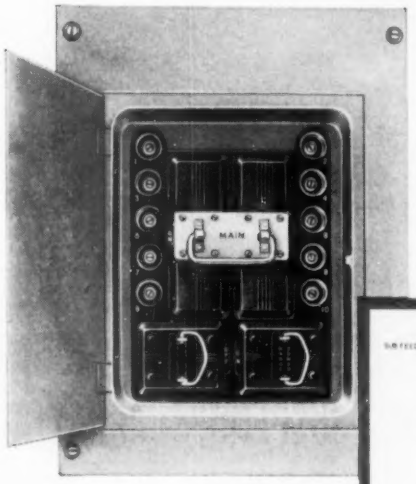
For easy and speedy installation the Easi-Mount is unsurpassed. Mounts to any half-inch knockout with expandable nipple, adjustable by outside set-screw. Can also be surface mounted. For door bells and chimes.

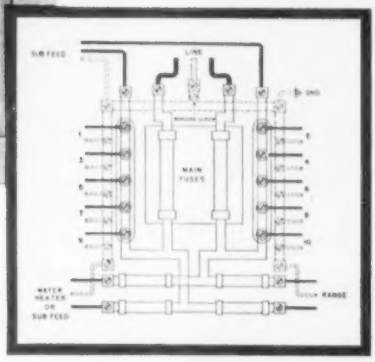
ASK YOUR WHOLESALER— OR WRITE FOR NEW ILLUSTRATED STAPLES BULLETIN

EDWARDS *Company, Inc.*

Dept. E. C. 9, NORWALK, CONN. In Canada: Edwards of Canada, Limited

ENGINEERED TO SAVE YOU TIME AND MONEY





WIRING DIAGRAM
Note how split solid neutral saves wire and wiring time.

ANY WAY you look at it, Noark® fusible service entrance equipment gives most for your dollars. Take the Noark 100 Amp. Main-and-Range Pull Switch! This switch is unusually attractive and low-priced. It meets load requirements of modern residences.

In the 100 Amp. Main-and-Range Switch, bus extension lugs permit sub-feeding to other centralized load panels. Split neutral bars, located beside the rows of plug-fuse terminals, save wiring time; simplify wire identification. Base is molded in one piece and whole interior is removable for quick wiring. The switch is compact... completely dead front.

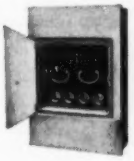
Order Federal Noark fusible service entrance devices from your wholesaler and cut your installation costs.

Federal Electric Products Co., 50 Paris Street, Newark 5, N. J.

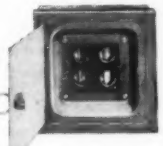
FEDERAL NOARK FUSIBLE SERVICE ENTRANCE EQUIPMENT

TYPE D SAFETY SWITCHES—supplied 30 through 400 amps. Raintight and general purpose enclosures.

60 AMP. MAIN-AND-RANGE PULLOUT SWITCHES—260 Series—available with 4, 6, 8 lighting circuits and with off-peak hotwater heater pullout. Surface, flush, and raintight enclosures.

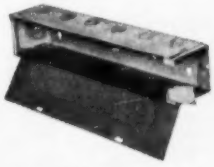


100 AMP. MAIN, RANGE AND WATER HEATER PULLOUT SWITCHES—12610 Series—available with 10 and 16 branch lighting circuits and with pullout for off-peak water heater circuit.



RESIDENCE PANELS—complete range of plug fuse lighting panels for flush or surface mounting.

MAIN SERVICE AND LIGHTING PANELS—160 Series—available with 2, 4, 6, 8 branch lighting circuits. 60 Amp. puller head can be used as main or branch circuit. Flush, surface, and raintight enclosures.



"AT" WIRING TROUGHS—4" x 4" and 6" x 6" sizes. 1, 2, 3, 4, 5-ft. sections. Have hinged cover, ample knockouts; keyhole slots for easy mounting.

Federal Noark products: Stab-lok Circuit Breakers, Motor Controls, Safety Switches, Service Equipment, Industrial Circuit Breakers, Panelboards, Switchboards, Control Centers, Bus Duct ★ Sales offices in principal cities.

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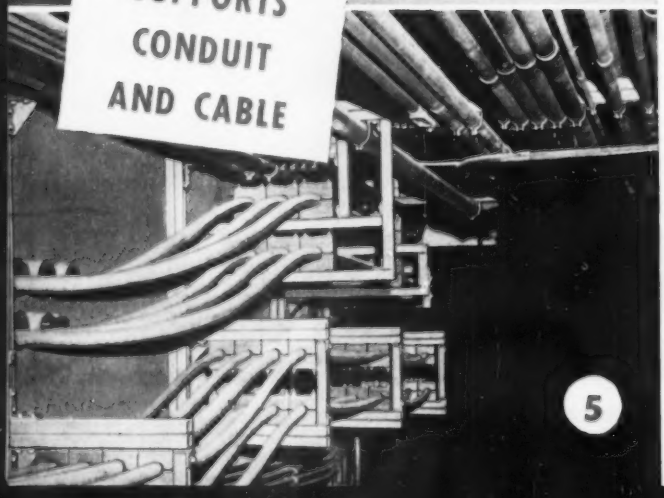
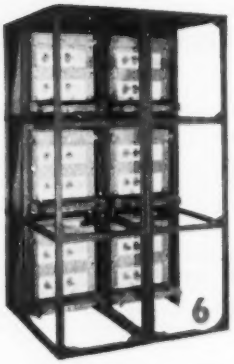


USE ADJUSTABLE UNISTRUT® METAL FRAMING TO MOUNT, FRAME, SUSPEND, SUPPORT ALL YOUR ELECTRICAL EQUIPMENT

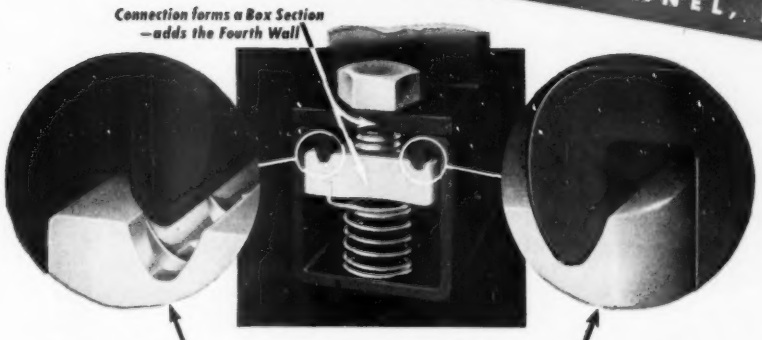
quickly, easily, at low cost— right on the job!



- **No welding, drilling, or punching**
- **Fast on-the-job assembly**
- **Reduces engineering detailing**
- **Eliminates errors**
- **Last minute changes easily made**
- **No waste—UNISTRUT is re-usable**

1. Showing portion of processing plant's motor control rooms with all control equipment supported by UNISTRUT channel, maple cable clamps and fittings.
2. UNISTRUT-supported fluorescent fixtures in machine shop. System provides perfect fixture alignment, added safety and better appearance.
3. UNISTRUT-supported heavy conduit run in large processing plant. UNISTRUT's extreme flexibility permits later additions or changes.
4. Bracing arrangement utilizes standard UNISTRUT channel and fittings in attaching the cable-supporting UNISTRUT framework to wall. Note porcelain insulating clamps.
5. UNISTRUT framing, porcelain and maple insulating cable clamps support cable and conduit.
6. Section of a draw-out switch cubicle completely framed with UNISTRUT channel and fittings.

This is UNISTRUT
the complete framing system



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Inturned Edges can't Buckle or Spread. Nut-to-Channel Locking Action holds Side Walls in Original Position

This Pyramid Shaped Edge has ⅓ more Bearing Surface than ordinary Flat-Edged Channel and Flat-Surfaced Nut

ONLY THE UNISTRUT FRAMING SYSTEM HAS THIS POSITIVE CLAMPING ACTION AT ALL POINTS OF CONNECTION!

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For the Man on the Job—packed with photos, drawings, ideas and data on how to frame, mount, rack and support electrical and mechanical equipment with UNISTRUT metal framing.

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The World's Most Flexible All-Purpose Metal Framing

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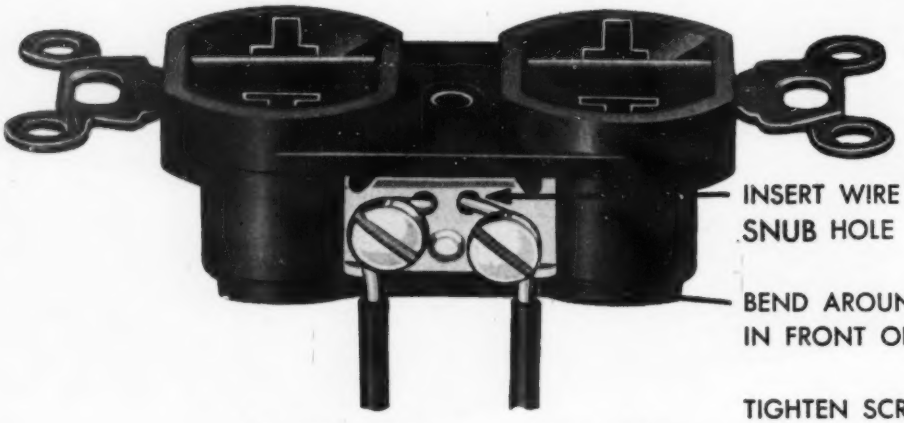
Easiest, most secure way to attach conductors

THE ANSWER IS
BRYANT
WIRING DEVICES

New "Hole-Snub" Wiring



No. 4832 — Duplex Convenience Outlet

ADDITIONAL FEATURES —

- Device has staked terminal screws-backed out
- Large head screws permit use of wire up to and including No. 10
- Double-sided contacts
- "T" Slots
- All-plastic body available in brown and ivory

BRYANT
SUPERIOR WIRING DEVICES

Listed by Underwriters' Laboratories, Inc.

THE BRYANT ELECTRIC COMPANY

Bridgeport 2, Connecticut

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J-99884

THE THREE CUTLER-HAMMER STARS ★ ★ ★
STAND FOR THREE NEW STANDARDS

☆ Installs easier

The cost of installing motor control today is usually much more than the cost of the control equipment, often two to three times as much. Thus this new control offers *large* savings.

☆ Works better

Users say, "Nothing like this ever before." Smooth, quiet operation with uniform response. New adjustable overload protection lets motors work harder with fewer nuisance interruptions.

☆ Lasts longer

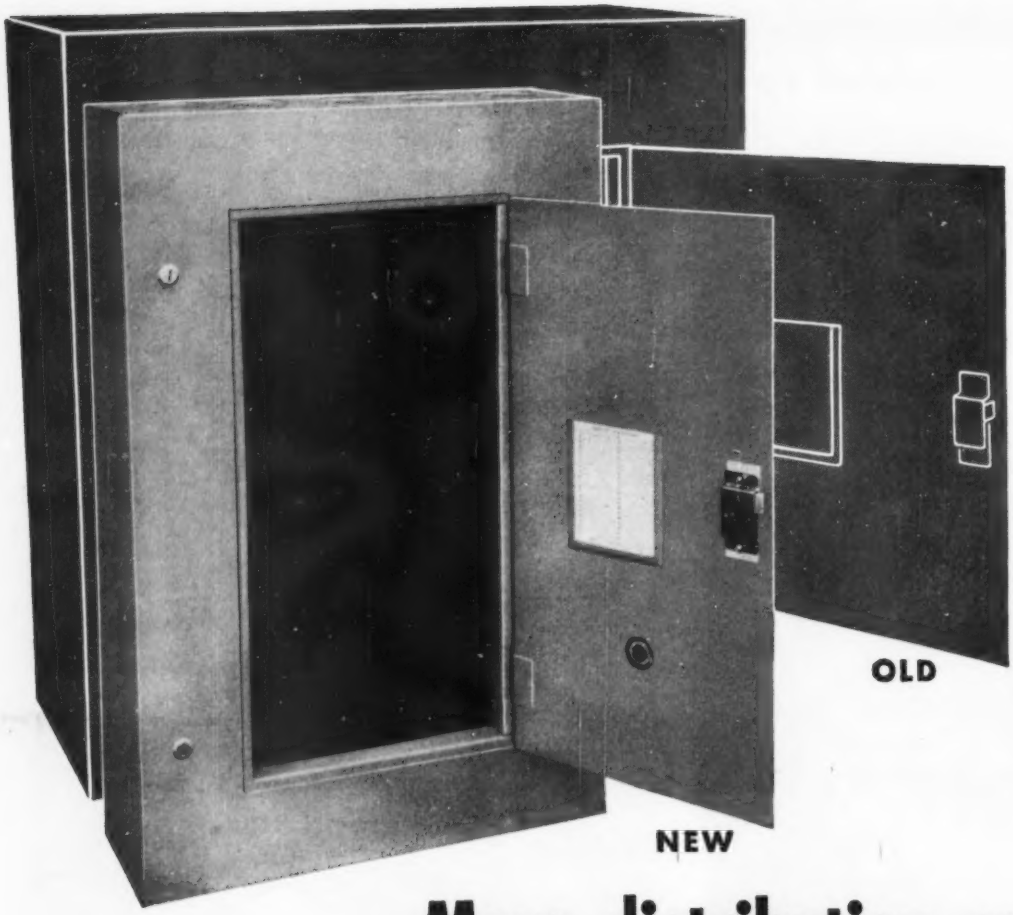
Revises all existing ideas of long trouble-free life in motor control. Cuts rate of wear to point that maintenance care and cost are virtually eliminated for 90% of all control uses.

Look for the three silver stars on the famous Cutler-Hammer nameplate; they identify the new spectacular Cutler-Hammer ☆☆☆ Motor Control. These three stars stand for three entirely new standards in motor control satisfaction and value. ☆ 1 . . . Easier, faster, lower cost installation any electrician can readily prove. ☆ 2 . . . Time-saving, trouble-saving, cost-cutting better performance which any test will confirm. ☆ 3 . . . Amazingly longer life due to advanced engineering features anyone can understand. Compare it by features and by performance. You too will say it is the finest control you know. CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin.

TRY IT !
COMPARE IT !
TEST IT !
PROVE IT !

Order from your nearby Authorized Cutler-Hammer Distributor today.

CUTLER-HAMMER ★★★ MOTOR CONTROL



More distribution capacity in less space

Here's a more compact Convertible Distribution Panelboard for 240-volt, a-c* applications, up to 600-amp capacity with main lugs, or 225-amp main breaker with branch circuit breakers up to 100 amperes, 1, 2 or 3 pole.

This new NDP Panel supplements the well-known Westinghouse Type CDP Convertible Distribution Panel. In a cabinet 20″ wide, it is now possible to obtain circuit capacities for single phase as well as 3 phase and 3-phase 4-wire service, which formerly required the use of 30″ wide cabinets.

Certainly this outstanding development points to savings in money, material and space. Take advantage of it now. Simply call your Westinghouse Representative or write for DB-30-930, Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pennsylvania. J-93495

*—*also 125/250 volt, 3-wire d-c systems*

YOU CAN BE SURE...IF IT'S

Westinghouse

The announcement of another "First" by Simplex is coming next month. It's another "First" to add to the distinguished company of the many others that have come from Simplex laboratories.

It will rank with TIREX "cured-in-lead" jackets, ANHYDREX low water-absorptive insulation, Simplex rubber-jacketed cables, TIREX gear-shaped insulated cables, ANHYDREX high temperature rubber insulation, and many others which have contributed so much to the perfection of rubber insulations.

Watch for the announcement. It will be important to you.

Simplex WIRE & CABLE CO.

79 Sidney Street, Cambridge 39, Mass.

CRESCENT

NEW IMPROVED GRAY

CRESFLEX

NON-METALLIC SHEATHED CABLE

CRESFLEX is the most suitable and lowest cost interior wiring system for all residential, farm and rural buildings. Here are the reasons why—

CLEAN OUTSIDE SURFACE. The outside is finished with a paint. On sizes #14 and #12, this paint is gray to prevent the marking of walls.

LASTING QUALITY. A rot-proof thoroughly saturated fiberglass overall braid is used.

CLEAN INDIVIDUAL CONDUCTORS. A treated paper dam prevents saturant from reaching paper-wrapped conductors.

EASY WORKING, because paper Armor pulls off easily and the Thermoplastic insulation strips free and clean.

CRESFLEX is available from your ELECTRICAL WHOLESALER'S stock.

CRESCENT
WIRE & CABLE

OVER 70 YEARS EXPERIENCE

CRESCENT INSULATED WIRE & CABLE CO.
TRENTON, NEW JERSEY

Washington Report

While Washington appears quiet to the casual visitor, since Congress adjourned and Administration officials hurried away on vacation, there is nevertheless much activity behind the scenes. It makes few headlines, but will contribute much to future Administration policy and action.

First, all Federal agencies are trimming fiscal (1954) expenditures to the bone. Second, they are all now working on 1955 budgets, with instructions to reduce spending below the current fiscal year level. This is at President Eisenhower's specific request, and part of the Administration's program to cut Federal spending, reduce taxes, and balance the budget.

Also, special groups, committees, and commissions are now engaged in a wide variety of tasks, all designed to aid in framing Federal policy and to shape Eisenhower's thinking on big questions. The new 12-man commission headed by ex-President Herbert Hoover to further streamline government, take it out of many fields of business if it doesn't belong, is one example. Committees studying housing, economics, debt limit, social security, taxes, resources, post office, military, etc., are others.

Business may soften by year's end, but any decline even during early 1954 will be minor, Eisenhower advisers report. There is more uncertainty beyond 1954 elections, however. Also, businessmen generally expect a mild recession starting some time next year, which they define as the end of the current boom—a return to normalcy.

A new business agency was set up in August within the Department of Commerce to aid business development. It will be the Business and Defense Services Administration, manned by personnel from the old National Production Authority, the former emergency controls agency. While details had not been completed late in August, it was planned that the new agency would continue NPA activities needed for defense production; also that it would establish industry divisions within the agency which would be the main Washington contact point for a company with a government problem. An electrical equipment division staffed with 12 industry specialists will serve the electrical industry when the agency is finally approved.

New building construction expenditures continue to boom along at new record levels. Commerce and Labor Dept. reports show dollar volume for first seven months at $19.3-billion, 8% above 1952 similar period. July expenditures hit a new monthly high—$3.3-billion, influenced by a "more than seasonal" gain in commercial construction. Current estimate for 1953 total is a record $34.6-billion, up one billion dollars over January forecast.

Home building is reported as slowing down more than seasonally, and financing at higher interest rates gets the chief blame. The agencies estimate that 1.1-million dwelling units will be started this year, or about 127,000 less than in 1952.

The Federal Housing Administration is experimenting with a plan which would stimulate new home construction and encourage old property improvement. Under this plan a builder would take an old house as a trade-in on a new home and get a favorable FHA insurance commitment.

Dispersion of new defense plants built during the past two years has been highly successful, Defense Department officials report. Four out of five plants are located 10 to 20 miles from congested areas, they reveal.

Electric power production climbs to new record highs almost weekly. Total energy distributed weekly crossed the 8.5-billion kilowatt hour mark early in August, up nearly 15% over the similar 1952 period.

Banish CONTROL nightmares with CLARK TYPE "CY" starters!

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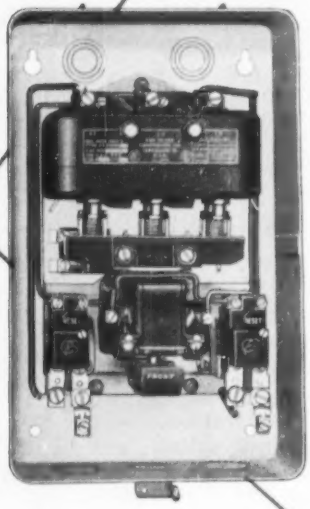

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- **Stationary contacts changed quickly!**
- **Remove only two screws and one pin to change coils!**
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- **Power circuit contacts available with springs, in complete packaged service kits for ease in stocking!**

● Type "CY" starters, Sizes 2 and 3, employ an entirely new principle of arc interruption. The arc is extinguished by the effect of the blow-out coil, concentric with the contact. The magnetic field quenches the arc either by lengthening or confining it. In its forced rotation it moves continually from a hot to a cold spot—minimizing burning or pitting of contacts. The ingenious design of the arc chamber prevents carbonization and the accumulation of hot gases between wiring terminals—minimizing phase-to-phase failures. Sizes 0 and 1 are built with the same mill-type construction as the larger sizes.

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SEPTEMBER . . . . *at a Glance*

Electric Heat

Now-a-days more and more electrical contractors are running into opportunities for the application of electric heating systems and ultimately somebody in the organization, usually the estimator, has the practical task of laying out the job.

Estimating building heating requirements is an everyday routine in the heating industry. It is covered by ample literature and references. The requirements for electric heating are also the subject of excellent pamphlets and data sheets prepared by the manufacturers of electric heating equipment.

With an eye to the electrical estimator's specialized viewpoint and requirements, we reviewed some of the currently available data and experience to develop the round-up "How to Estimate Electric Heating Systems" beginning on page 108. An important feature of the article is the use of equivalent electrical terms and data in place of conventional heating terms. A factor of "20 watts per square foot heat loss at 60 degrees temperature difference" is, to an electrical man, a more tangible figure than its heating equivalent of "1.13 Btu per hour heat loss per square foot per degree for a temperature difference of 61 deg."

The Code

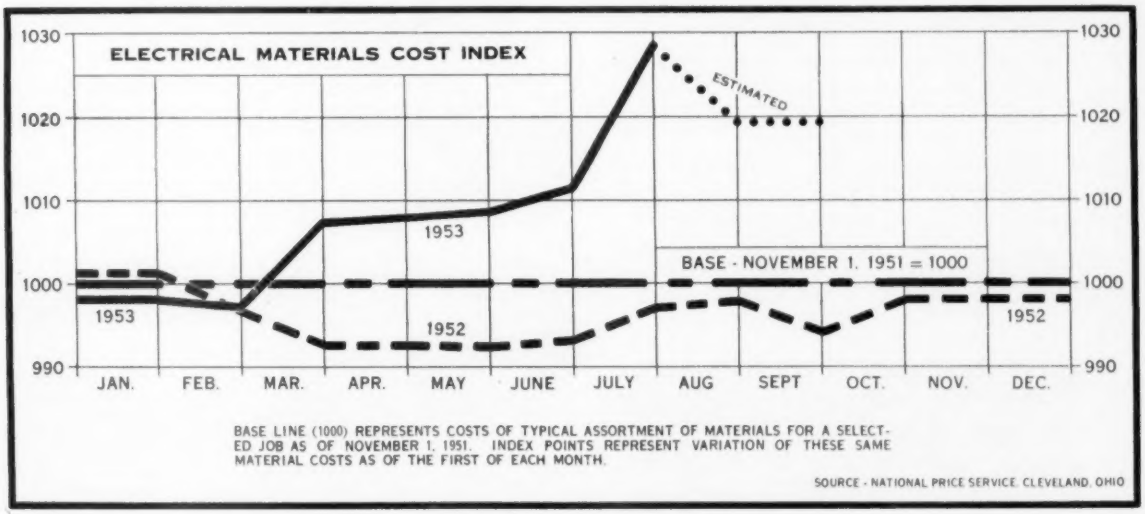
Distribution of the new 1953 National Electrical Code is expected to begin this month. In this issue, a special report is devoted to the revisions. We believe this is the first time a detailed analysis of a major Code revision has reached such a large audience concurrently with the publication and distribution of the new Code. Behind the job is several months of planning for the actual preparation which had to be handled quickly between the final committee actions and our copy deadline. The wheels started moving last April at a luncheon with Chas. L. Smith in Chicago. The project went into high gear in Rochester, a little more than a month ago where, armed with notes and reports, B. A. McDonald and Editor Stuart conferred on the scope and framework of the text report. In New Orleans, B. Z. Segall was rushing rough sketches for a new volume of his monumental "Electrical Code Diagrams." When completed the original rough manuscript material was air mailed to New York and illustrations selected from it. While McDonald's text and Segall's drawings were being correlated Smith in Chicago reviewed the galleys. In spite of the short lead time and the far flung geography of the operation, the pieces came together smoothly in time for this issue of your magazine.

Lighting Contest

Winners in the National Lighting Competition for Electrical Contractors are announced on page 211. Actual details of prize winning jobs will be presented as a special report in the October issue. Contest Chairman Cooper's enthusiasm for this project was soon shared by all hands when the sealed entries were opened and we had an opportunity to appraise the quality of the work submitted. Particularly significant to us was the generally high level of competence disclosed in the entries which did *not* wind up among the winners. An important measure of success for any contest is the quality of the field from which the winners are selected.

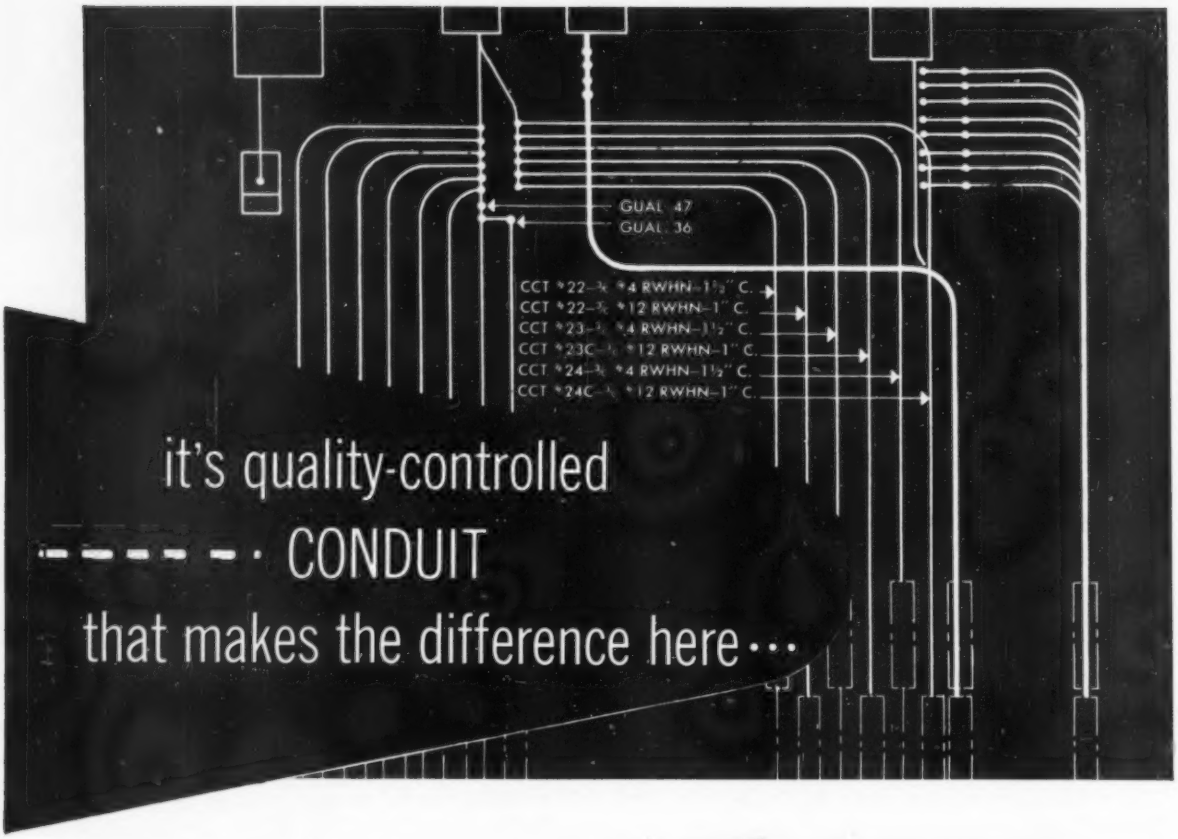
Extra Issue

Shortly after this regular September issue reaches your desk you will receive your Mid-September Electrical Products Guide issue. The Guide is an extra in addition to your 12 regular monthly issues and it comes to you as a part of your regular subscription.



BASE LINE (1000) REPRESENTS COSTS OF TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. INDEX POINTS REPRESENT VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.

SOURCE - NATIONAL PRICE SERVICE, CLEVELAND, OHIO



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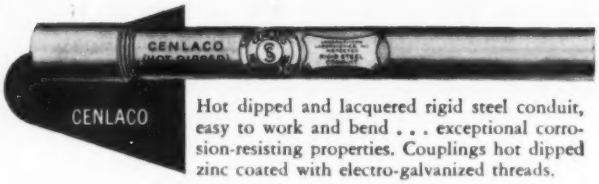
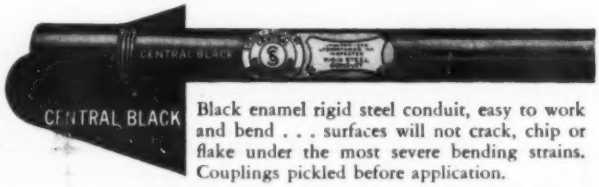
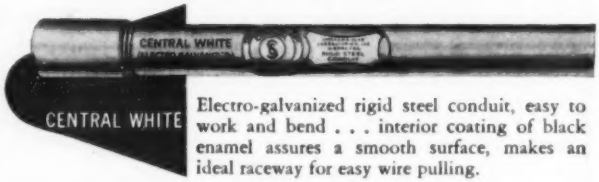


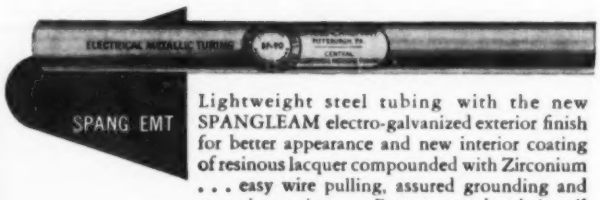
CENLACO — Hot dipped and lacquered rigid steel conduit, easy to work and bend . . . exceptional corrosion-resisting properties. Couplings hot dipped zinc coated with electro-galvanized threads.



CENTRAL BLACK — Black enamel rigid steel conduit, easy to work and bend . . . surfaces will not crack, chip or flake under the most severe bending strains. Couplings pickled before application.



CENTRAL WHITE — Electro-galvanized rigid steel conduit, easy to work and bend . . . interior coating of black enamel assures a smooth surface, makes an ideal raceway for easy wire pulling.



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ELECTRICAL CONSTRUCTION AND MAINTENANCE

52nd Year—SEPTEMBER • 1953

Breaking Point

THE FUTURE HISTORY of electrical development will one day devote more than ordinary recognition to one of our contemporary appliances. The room air conditioner is loading existing wiring systems beyond the breaking point and trouble is popping everywhere in full public view.

MANY NEW YORK CITY APARTMENT dwellers this summer received an order from their landlords to remove forthwith all room coolers because the overload on the building electrical systems had reached the point of imminent danger to life and property. In that great city of apartments one 15 ampere circuit per apartment is common, more than two exceptional and the feeders are proportionately lean.

MOST OF OUR COMMERCIAL BUILDINGS also were erected before 1930. They were wired for incandescent lighting. The two and a half times gain in light output per watt from fluorescent lighting systems ten years later gave their electrical systems a brief new lease on life. Metal boxes of air coolers projecting from window sills now mark areas where continuous loads are suddenly increased by 3 or 4 watts per square foot in buildings with a probable system capacity of 2 watts per square foot or even less.

PROHIBITION OF THE USE of room coolers is a pathetic gesture that may relieve some desperately dangerous conditions through the end of this cooling season. But it cannot and will not be tolerated by a public already convinced that the room cooler is one of the greatest boons to city life since the advent of central heating.

WIRING MODERNIZATION is the only practical alternative. The awful certainty that room cooler use will multiply at a fantastic rate for years to come precludes minor modification of the outlet and branch circuit variety. It will take complete electrical rebuilding from basement to pent house at design capacities at least double those which heretofore have been considered liberal. This represents a great market opportunity for electrical contractors.

FARSIGHTED MANAGEMENT will, in due course, protect its property values by electrical modernization. Ultimately, however, the public interest may have to be protected by compulsory reinspection and condemnation of commercial properties where electrical wiring is incapable of handling safely a normal and reasonable use of lights and appliances.

AUTOMOBILE INSPECTION provides an important and significant precedent. Many states now require periodic reinspection of motor vehicles. Those which do not meet modern safety standards are promptly ruled off the road as a potential menace.

OBSOLETE WIRING SYSTEMS present much the same kind of hazard. Entirely satisfactory in their day, continued use in a period of rapid load growth creates a mounting menace. The risk is measurable and predictable by expert electrical inspection techniques. Such systems should be modernized or ruled "off the road" before they can contribute to fire and accident statistics.

Wm. T. Stuart

A COMPLETE SELECTION OF LIGHTING EQUIPMENT — Just consider the many different installations shown in this typical plant lighting system. Yet, from your local Graybar office you can conveniently order equipment for these or any other lighting applications. See for yourself — you'll save time and paper work when you *call Graybar first.*

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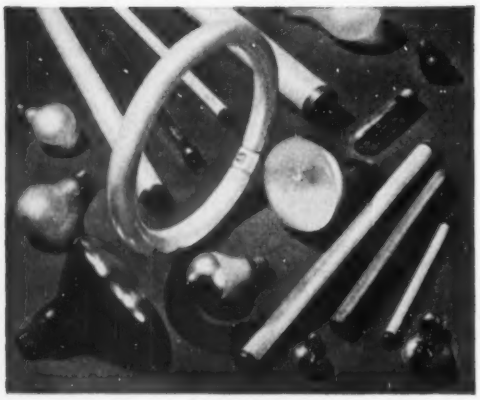

10,000 LAMPS. Graybar distributes every type and size of lamp you might require. They're all G-E, so your customers get the best in quality and long service.

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By calling a Graybar Lighting Specialist, you can get absolutely impartial advice on the fluorescent, incandescent, or mercury vapor system best-suited to any particular lighting requirement. You can be sure that the finished installation has been selected with consideration of both initial and operating costs . . . that it has been properly applied . . . and that it provides adequate over-all lighting intensity.

Graybar also distributes more than 100,000 other electrical items for wiring, power, ventilation, as well as lighting.

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IN OVER 100 PRINCIPAL CITIES

A Special Editorial Report on the new

Code Revisions, 1953

Covering the changes which will appear in the new Code with an expert analysis in text and diagrams by two of our foremost contemporary authorities on the National Electrical Code, B. A. McDonald[1] and B. Z. Segall,[2] technical review by Chas. L. Smith.[3]

This report is unique in the history of the National Electrical Code. It is the first time that such an extensive analysis of a periodic revision has been presented to a large industry-wide audience concurrent with the publication of the new Code. We hope that this project will contribute importantly to wide understanding of the new provisions and their speedy adoption and application to practical electrical installations.

In the selection of authorship and sources no effort has been spared to make this report authoritative and accurate. In order to limit its physical dimensions for practical presentation, many editorial changes, revisions relating to the design of products and some other specialized provisions have been omitted by the editors. Technical review by Chas. L. Smith has provided most useful guidance to the authors and the editors but is not necessarily an endorsement by him of the report. Opinions, interpretations and comments are those of the authors.

THE 1953 Edition of the National Electrical Code, sponsored by the National Fire Protection Association, completely replaces the 1951 edition, and is outstanding in view of the numerous changes in the interests of safeguarding persons and property from electrical hazards, changes in the interests of clarity, additions to recognize new materials, devices and methods, provisions to cover the continued increasing scope of the hazards presented by gases, vapors and dusts, extended recognition of the personal injury and life hazard presented by Occupancies such as Hospital Operating Rooms, Theaters, Night Clubs and many other similar types used for public assembly. All of us, who are familiar with the electrical wiring industry, are aware of the increased use and application of electricity during the past few years but few of us realize the difficult task of formulating rules to keep abreast with such rapid progress. The new 1953 Code has to a major degree brought us up to date in this respect. Tomorrow, there will be another problem and this is as it should be because, the day new problems cease, we will not progress.

In view of the extensive revision, it is impracticable in an article of this nature to cover all of the changes involved. It has therefore been necessary to slight some very important changes which occur under the general heading of "Special Occupancies" in Chapter 5 and also "Special Equipment" covered by Chapter 6. The decision to do so was influenced by the fact that the vast majority of the people who use and apply the Code daily are primarily concerned with changes which concern their daily procedure. Many of them rarely contact a special occupancy or are involved with special equipment. As a result, we have given particular attention to changes and additions which are most important to the vast majority of the people who use the Code daily. We urge these folks however to read and become familiar with the new requirements covering special occupancies and equipment, not only in their own interests but also to the end that when the occasion arises, they are informed and are better equipped to serve and represent the electrical wiring industry.

During the past two and a half years a large majority of the Code Panel Members have given generously of their time, experience and knowledge in the development of this new Code edition. I believe all of us, concerned and benefited, owe the National Electrical Code Committee, its Chairman Merwin Brandon and its Secretary Charles L. Smith, an expression of our appreciation for the services they have rendered in the interests of Electrical Safety.

The following covers the changes and additions which we consider significant. You may not fully agree with our

FOOTNOTES: 1. Electrical engineer, New York Board of Fire Underwriters; formerly chief electrical inspector, Rochester, N. Y.; Consulting editor, *Electrical Construction & Maintenance*. 2. Consulting Electrical Engineer; author of "Electrical Code Diagrams"; Consulting Editor, *Electrical Construction and Maintenance*. 3. Electrical Field Engineer, N.F.P.A., Secretary-Treasurer, International Association of Electrical Inspectors, revising author "National Electrical Code Handbook," Secretary, National Electrical Code Committee.

opinion in this respect. If so, do not hesitate to let us know since it is possible that your requests could be covered later either under our "Code Question" department or as a special article. You gentlemen, in the field, have been the source of information which has influenced Code revisions, to an extent greater than any other source. You also have made a major contribution in the development of the Code. Your opinions and criticisms are welcomed. They are essential in the future, as they have been in the past, if we wish to achieve constructive progress.

As a last word, I would like to offer an opinion. Irrespective of our personal opinions on some features of the Code, I believe our industry has an instrument, for good, that is not common to other industries especially concerned with the building industry. This instrument is the N.E. Code. We should support it and promote it. We all have just reason to be proud of the results it has achieved. We all should cooperate in its further development and improvement.

ARTICLE 210—BRANCH CIRCUITS.

Section 2103. CLASSIFICATION. The second sentence has been changed to read:

"When conductors of higher capacity are used for any reason, the rating or setting of the specified overcurrent device shall determine the circuit classification."

PANEL COMMENT: The present Code recognizes the use of larger conductors for voltage drop but does not mention that it is necessary at times to use larger conductors in raceways because of 80 and 70 percent reduction factors which are required by Note 4 of Table 1, Chapter 10. The new change will permit larger conductors for this purpose without changing the circuit classification.

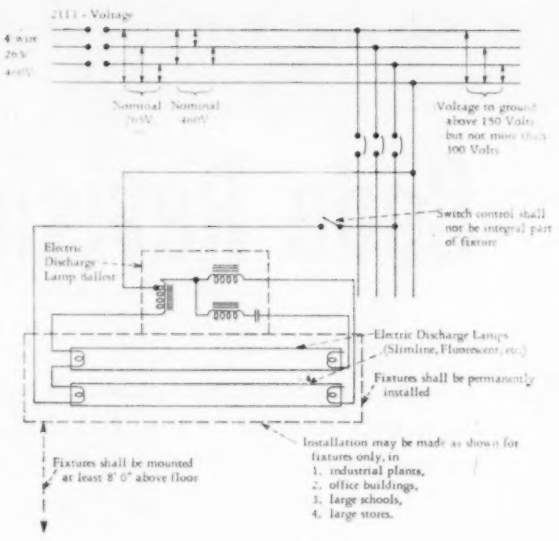
Section 2112. COLOR CODE. A new paragraph has been added to this Section which eliminates the use of a conductor with a green covering for any purpose other than a grounding conductor.

PANEL COMMENT: The panel noted the continued confusion over the requirement for the color coding of grounding conductors in flexible cords but not in branch circuit conductors and felt that green should be reserved exclusively for the identification of grounding conductors.

PERSONAL COMMENT: At the present time, the Code would permit a conductor with a green covering to be used as a circuit conductor when more than one multiwire branch circuit is carried through a single raceway. The new provision eliminates such use. As a result, compliance with this provision will result in establishing a standard for a covered grounding conductor and as time passes, we will find that any time a green covered conductor is present, we will know that it is, or is intended to be, a grounding conductor. This provision should not be confused with the white or natural grey colored circuit ground conductors, which is, in no way involved with the new provision. The distinction between a grounding conductor and a grounded conductor must be observed.

Section 2113. VOLTAGE

A new provision has been added to this Section which extends the use of 300 volts to ground circuits for the purpose of supplying ballasts for electric discharge lamps, in permanently installed fixtures, mounted not less than 8′ from the floor which do not have *manual* switch control as an integral part of the fixture. This intended use is restricted to industrial establishments, office buildings, large schools and stores. The present 1951 Code has a similar provision which applies only to industrial occupancies. There is a distinction between the two provisions which should be noted. The new provision applies only when the branch circuit conductors supply ballasts for electric discharge lamps while the present provision, which continues in the Code, may supply other types of lampholders, such as the mogul-base screw shell type. The new provision covers not only industrial establishments but in addition, office buildings and large schools and stores. The present provision prohibits any type of switch control to be installed as an integral part of the fixture while the new provision only prohibits manual switching. This indicates that relay switching could be used to control fixtures under the new provision.


2113 - Voltage
Nominal
Nominal
Voltage to ground above 150 Volts but not more than 300 Volts
Switch control shall not be integral part of fixture
Electric Discharge Lamp Ballast
Electric Discharge Lamps (Slimline, Fluorescent, etc.)
Fixtures shall be permanently installed
Installation may be made as shown for fixtures only, in
1. industrial plants,
2. office buildings,
3. large schools,
4. large stores.
Fixtures shall be mounted at least 8' 0" above floor

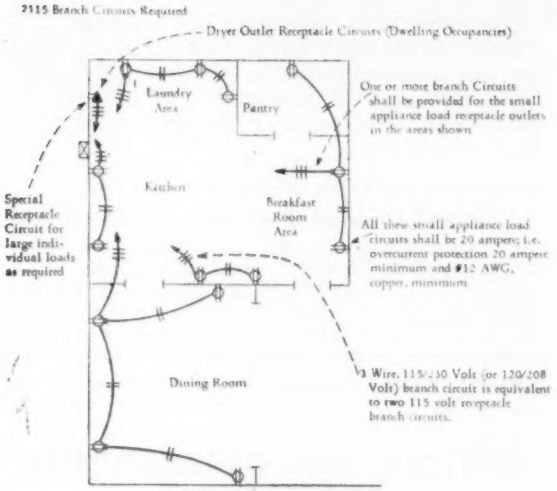
In support of this new provision Panel No. 2 offers the following comment:

"The proposed new wording extends the use of 277 volt to neutral supply, to additional occupancies only where the higher voltage circuits supply the ballasts of fluorescent lighting fixtures. Since power at 480/277 Y volts is not generally available except from unit substations or transformation equipment installed at the particular occupancy the limitation to 'office buildings' and 'large schools and stores' seems to supply the necessary assurance that this system will not be encountered in small detached store buildings or in the ordinary primary school buildings."

Section 2115, b. RECEPTACLE CIRCUITS (Dwelling Occupancies)

This Section has a slight revision which definitely states that the circuit or circuits required to supply the small appliance load in the kitchen, laundry, pantry, dining room and breakfast room of dwelling occupancies must be 20 ampere branch circuits. The previous wording required that No. 12 conductors be used with no reference to the circuit classification.

A new fine print note has been added as follows:


2115 Branch Circuits Required
Dryer Outlet Receptacle Circuits (Dwelling Occupancies)
Laundry Area
Pantry
One or more branch Circuits shall be provided for the small appliance load receptacle outlets in the areas shown
Kitchen
Breakfast Room Area
Special Receptacle Circuit for large individual loads as required
All these small appliance load circuits shall be 20 ampere; i.e. overcurrent protection 20 ampere minimum and #12 AWG, copper, minimum
Dining Room
3 Wire, 115/230 Volt (or 120/208 Volt) branch circuit is equivalent to two 115 volt receptacle branch circuits.

"A three wire 115/230 volt branch circuit is the equivalent of two 115 volt receptacle branch circuits."

A third and fourth sentence has been added to this Section which requires a branch circuit or a branch circuit raceway, which supplies a grounding receptacle as covered in Sections 2124 b and 2559, to include or provide a grounding conductor to which the grounding contacts of the grounding receptacle shall be connected. The use of a grounded metal raceway or cable armor would also be recognized for the same purpose. As a result of this new provision, it would be necessary when installing the appliance branch circuit in a residential occupancy, by the use of non-metallic sheathed cable, to see that such a cable is provided with a grounding conductor.

Section 2133-b. RECEPTACLES. The second paragraph of this Section has been changed to require receptacles connected to circuits having different voltages, frequencies or types of current (ac or dc) on the same premises to be so designed that attachment plug caps used on such circuits are not interchangeable.

PANEL COMMENT: Reason for change: The present code only requires that attachment plug caps cannot be interchangeable if connected to circuits of over 150 volts between conductors. **This permits 115 ac and 115 dc** circuits to have the same type of receptacles on the same premises as circuits of different frequencies and less than 150 volts between conductors, and in addition, 6, 16, 24 volts, etc., circuits to be the same as the 115 volt receptacles. This condition is just as hazardous as using the same receptacles for 115 and 250 volt circuits on the same premises. The new proposal will require all receptacles to be of a different type for circuits of different voltages, frequency, or types of current (ac or dc) and will consequently eliminate the obvious hazards connected therewith.

ARTICLE 220—FEEDERS.

Section 2201. Feeder Size. The first sentence of the first paragraph of this Section has been deleted and the following substitution made:

"Feeder conductors shall have a current rating not smaller than the feeder load as determined by Section 2203."

Reference to the present requirements shows that the provision requiring feeder conductors to be subject to the carrying capacities covered by Tables 1 and 2 of Chapter 10 has been eliminated. The intent of the new wording is to clarify the position of bare conductor and busway feeders.

Section 2202. VOLTAGE DROP.

This Section has been reworded to include electrical space heating. It therefore follows that the present Code provision for voltage drop will apply not only to power and lighting loads but also to heating loads.

Section 2203-a. GENERAL LIGHTING. SCHOOL BUILDINGS.

Table B which covers the demand factors for various types of occupancy has been changed to eliminate any demand factor in a school building. The total wattage, 100% demand, must be used in figuring such feeders. The panel felt that present day illumination practices and loading demands do not justify less than 100% of the unit loads in Column A.

A change also has been made for office occupancies. The present 2 watts per square foot has been increased to 3 watts and the 20,000 watt load subject to a 100% demand factor has been increased to 30,000 watts. The Panel feels that the increased levels of illumination in current construction justifies this increase in feeder sizes. They call attention to the fact that the increased use of portable air conditioners has aggravated the need for this increase.

Section 2203-e. FIXED APPLIANCES. Calculating Load.

This Section has been rewritten to exclude electric space heating equipment in applying the 75% demand factor as recognized in the present rule for appliances other than ranges. The special technical Committee on Panel Heating felt that such a demand factor should not apply to space heating, since this question is covered by new Section 2203-h which follows immediately.

Section 2203-h. FIXED ELECTRICAL SPACE HEATING.

This is a new and original provision for computing the load of a feeder which supplies fixed electrical space heating equipment and requires the total connected load on all branch circuits to be used. An exception occurs where reduced loading of the conductors results from units operating on duty cycle, intermittently, or from all units not operating at one time. The authority enforcing this Code may grant permission for feeder conductors to be of a capacity less than 100%, under the above conditions, provided the conductors are of sufficient capacity for the load so determined.

This new rule leaves the question of feeders for space heating in the hands of the Inspector and may be subject to criticism in view of the absence of any definite requirement. We should not however be too hasty with our criticism. The variables which are involved with this problem are many and it would be difficult to set up fixed demands which would reasonably satisfy all conditions without resort to several pages of requirements. The Code in several instances delegates the decision to the Inspector in line with prevailing conditions. This, I believe to be the case in this instance and this requirement appears to be the logical solution to the problem at this time.

ARTICLE 230—SERVICES.

Section 2303-A. UNINSULATED NEUTRAL.

At the present time, the Code permits in the case of service conductors that have a nominal voltage to ground of not more than 208 volts, a grounded neutral service conductor without an insulating covering to be installed. This voltage to ground has been increased to 300 in the new Code. The comment in support of this change is as follows:

COMMENT: The proposal was made after reports from a number of areas in the field indicated that grounding of the corner of 240-volt delta installations to obtain greater protection by "Interconnected grounding" is increasing and it was requested that voltage limitation be raised from "208" to "300" volts. The panel was of the opinion that there was no hazard involved and that the change would encourage more "inter-connected grounding" which would improve safety factor.

Section 2311—MECHANICAL PROTECTION. UNDERGROUND SERVICES.

This Section has been clarified with respect to the use of single conductor cables underground. The new wording refers to a cable of *one or more* conductors approved for the purpose. This change definitely answers a question which has been the source of controversy for several years.

Section 2322-c and Section 2333. CLEARANCE FROM BUILDING OPENINGS.

The present Code requires service drop conductors to have a clearance of not less than 36 inches from windows, doors, etc. A new sentence has been added to the present Code. It reads as follows: "See fine print note Section 2333". This fine print note is new and reads as follows: "Conductors run above the top level of a window are considered out of reach from that window."

Section 2351-A. SERVICE DISCONNECTING MEANS. SWITCH AND CIRCUIT-BREAKER.

According to the present Code the service disconnecting means is limited to six switches or six circuit-breakers. This Code provision has been greatly extended by the insertion of a new sentence which reads as follows: "Two or three single pole switches or breakers, capable of individual operation, may be grouped on multi-wire circuits (where applicable, see Section 2353) as one multi-pole disconnect provided they are equipped with handle ties, handles within ¼ inch proximity, a master handle, or other means, making it practical to disconnect all conductors of the service with no more than six operations of the hand."

PANEL COMMENT: "This change was suggested for clarity to avoid misunderstanding in the field with particular reference to handle ties and proximity of handles on single pole breaker assembled to form one of a group of breakers."

This new provision in part apparently recognizes on a three phase, 4 wire service, a disconnecting means consisting of 18 single pole switches or breakers provided the handles are within ¼ inch proximity; and the combination is approved for service use. On a single phase, 3 wire service, twelve breakers or switches arranged as provided could also serve as the service disconnect.

Section 2352. CONNECTIONS AHEAD OF DISCONNECTING MEANS.

In addition to the equipment now permitted to be connected on the supply side of the disconnecting means, fire pump equipment has been added. This appears logical since the Code, under Section 2321, permits fire pump equipment to be served through separate service drops when required.

Section 2357. RATING OF SERVICE SWITCH.

A new sentence has been added which reads as follows: "Where multiple switches or circuit breakers are used in accordance with 2371-a-3, the ratings of the service equipment shall not be less than the minimum specified in this Section".

COMMENT: This is to provide for minimum size service equipment when multiple switches and breakers are used.

ARTICLE 240—OVERCURRENT PROTECTION.

Section 2403-a. FUSES

The second sentence of this Section has been revised to clarify the use of plug fuses and fuseholders on circuits exceeding 125 volts between conductors provided they are supplied from a system having a grounded neutral and no conductor operates at more than 150 volts to ground.

COMMENT: There has been some misunderstanding as to where plug fuses may be used particularly in reference to water heater circuits not using a grounded neutral circuit conductor.

The new wording more definitely recognizes the use of a 230 volt, 2 wire water heater or a 220 volt single phase motor, each protected by plug fuses, when connected to a 3 wire, 115-230 volt service with the neutral grounded. It would also recognize similar use when a three phase, 4 wire, wye connected, 208-120 volt service was involved.

A second paragraph has been added to this section as follows:

"Ampere ratings for fuses are 15, 20, 25, 30, 35, 40, 50, 60, 70, 80, 100, 125, 150, 200, 250, 300, 400, 500 and 600. Fuses of a size other than the standard sizes may be used if they are of a size smaller than those included in the standard list."

COMMENT: It was thought the necessity to determine the next higher standard rating and setting of overcurrent protective devices indicated a need for these values in the Code. The last sentence was added to clarify the position of fuse sizes smaller than those included in the standard list.

Section 2403-b. NON-ADJUSTABLE-TRIP CIRCUIT-BREAKERS.

A second paragraph has been added to this Section as follows:

"Ampere ratings for molded case circuit breakers are 15, 20, 30, 40, 50, 70, 100, 125, 150, 175, 200, 225, 250, 300, 350, 400, 500 and 600."

The comment on fuses also applies to this change.

Section 2457. DAMP OR WET LOCATIONS.

The present Code requires enclosures for overcurrent

devices in damp or wet locations to be mounted so there is at least one-half inch air space between the enclosure and the wall or other supporting surface. The one-half inch provision has been changed to one-fourth inch.

The present requirement is in conflict with Section 3732. The change rectifies same. The change from one-half to one-fourth was made in 1949 but was omitted in Section 2437. This is now corrected.

ARTICLE 250—GROUNDING.

Section 2533. OTHER CONDUCTOR ENCLOSURES.

The present Code requires metal enclosures for conductors to be grounded, *except* in runs of 25 feet which are free from probable contact with ground or grounded metal and which, if within reach from grounded surfaces, are guarded against contact by persons. This exception has been changed to read:

"*except* in runs of 25 feet which are free from probable contact with ground, grounded metal, *metal lathe or conductive insulation* and which, if within reach from....."

COMMENT: This change intends to safeguard the fire or shock hazards presented where conductive or semi-conductive thermal insulation is installed in walls or other areas.

Section 2545-c. PORTABLE EQUIPMENT.

The present Code requires, in other than residential occupancies, that the exposed metal parts of portable appliances used in damp or wet locations, or by persons standing on the ground or on metal floors or working inside of metal tanks or boilers to be grounded with the 50 volt exception.

The new rule also includes portable tools which are likely to be used in wet and conductive locations and not protected by insulated handles and enclosures.

PANEL COMMENT: This proposal was a joint assignment of Code Making Panels No. 2 and No. 5 and is in accordance with the September 1946 report of Special Sub-Committee of Article 250. (Secretary's Note) Quite a number of Electrical Inspectors are of the opinion that some provision should be included for the required grounding of non-current carrying metal parts "in residences" or "outside of residence" of such equipment as portable yard tools and package air conditioning units which extend outside of a window of a residence and within reach from the ground.

The new provision makes a distinction between a portable appliance and a portable tool. If the tool were protected by an insulated handle and enclosure, it would be exempt from grounding.

Section 2559. PORTABLE EQUIPMENT.

This Section has been changed to read:

"Non-current carrying metal parts of portable equipment may be grounded in any one of the following ways:

"A. By means of the metal enclosure of the conductors feeding such equipment, provided an approved plug is used, one fixed contacting member for the purpose of grounding the metal enclosure, and provided, further, that the metal enclosure is attached to the plug and to the equipment by connectors approved for the purpose.

"(Fine print note) See note following Section 4010."

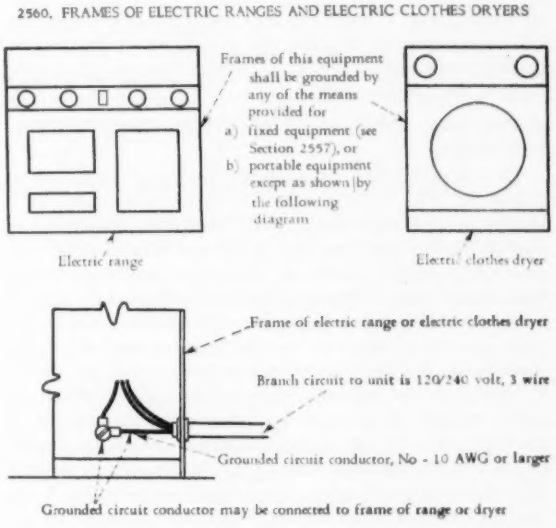
The terms "multiprong" and "or equivalent" have been deleted and the word "prong" has been replaced with the words "fixed contacting member." The fine print note in Section 4010 advises that this requirement becomes effective January 1, 1955.

COMMENT: At the present time the Code recognizes a means of grounding portable equipment similar to the above new provision. The effective date of the new provision has been delayed until January 1, 1955.

Section 2559-c. This method of grounding portable equipment which involves the use of a separate flexible wire or strap has been restricted to a degree by the insertion of the term "by special permission." This term however does not apply where such wires or straps are a part of an approved portable equipment. The significance of this change is difficult to evaluate at this time. The term "approved portable equipment" is a factor of considerable importance and only time will show the degree of restriction intended by the new wording.

Section 2560. FRAMES OF ELECTRIC RANGES AND ELECTRIC CLOTHES DRYERS.

This Section has been changed to recognize the grounding of the frames of electric ranges and electric clothes dryers to the grounded circuit conductors provided they


2560. FRAMES OF ELECTRIC RANGES AND ELECTRIC CLOTHES DRYERS
Frames of this equipment shall be grounded by any of the means provided for
a) fixed equipment (see Section 2557), or
b) portable equipment except as shown (by the following diagram
Electric range
Electric clothes dryer
Frame of electric range or electric clothes dryer
Branch circuit to unit is 120/240 volt, 3 wire
Grounded circuit conductor, No - 10 AWG or larger
Grounded circuit conductor may be connected to frame of range or dryer

are served by 120-240 volt, three wire branch circuits and the grounded circuit conductors are not smaller than No. 10 AWG.

At the present time, ranges may be so grounded without any restriction as to voltage under this Section.

COMMENT: It appears that the reasons for permitting the grounding of electric ranges to the neutral are equally applicable to electric clothes dryers since the appliances are similar and the same type construction facilities would be used.

Section 2574. CONTINUITY AT OTHER ENCLOSURES.

Add a new Section 2574, renumbering present Section 2574, 2575, 2576 and 2577.

New Section 2574 reads as follows:

"The electrical continuity of metallic raceway systems and cable armor that are to serve as grounding conductors shall be assured. At points where raceway or armor

connects to metal enclosures, any non-conducting coating which might interrupt such continuity shall be removed unless fittings are used which are so designed that such removal is unnecessary."

COMMENT: This new provision clarifies a question which has arisen in the past, and should promote better conductivity over metal raceways which are used as grounding conductors.

Section 2574. VOLTAGES EXCEEDING 150 VOLTS.

At the present time the Code requires that the electrical continuity of metal raceways or cables which contain any conductor of more than 150 volts to ground shall be assured by the use of any of the provisions of Section 2572 or by the use of double locknuts. The new provision raises the 150 volt value to 250 volts. The principal reason for the change concerns the three phase, 4-wire delta connection which results in 240 volt, 3 phase current for power and single phase 120-240 volt current for lighting. The highest voltage to ground on such a combination is 208 volts on one phase wire only; the other two phases operate at 120 volts to ground. While the original objective was to increase the voltage only to 208 volts and thus satisfy the confusion which has arisen on 3 phase, 4 wire delta systems, the panel members decided to raise the voltage to 250 volts. As a result, all three phase, 3 wire 240 volt delta systems no longer will be required to improve the continuity of their metal raceway enclosures, beyond the service equipment as now covered by Section 2574.

Section 2592. INSTALLATION. (GROUNDING CONDUCTORS)

This Section has been subdivided into two parts, a and b. The new Section 2592-a pertains only to a System or Common Grounding Conductor and remains practically the same as now written. Section 2592-b is new and pertains only to Conductor Enclosures and Equipment Only. Thus a distinction has been made between a grounding conductor for a system and one used only for equipment. At the present time, the Code requires grounding conductors smaller than No. 6 to be installed in conduit, electrical metallic tubing or cable armor. This provision prohibits the use of a No. 14 or No. 12 grounding conductor in a non-metallic sheathed cable assembly and the use of conductors smaller than No. 6 when protected from mechanical injury. Both procedures have been common practice in many areas. The new provisions of Section 2592-b recognize such use through a new exception which reads as follows: "except that where smaller than No. 6, as permitted by Section 2595, it need not be armored or installed in a raceway if run through the hollow spaces of a wall or partition or otherwise run so as to be not subject to mechanical injury."

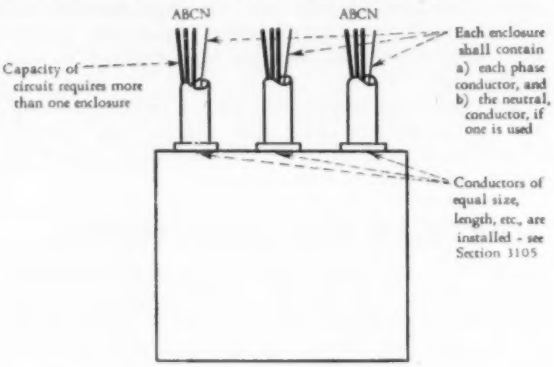
Section 2622. INSTRUMENT TRANSFORMER CASES.

The present rule requires the cases of instrument transformers, under certain conditions, to be grounded. This provision has been tempered to apply only when such cases or frames are accessible to other than qualified persons. This new provision recognizes the alternate method of protection, isolation and guarding, which is expressed under the fundamental covered by Section 2501-Scope.

Section 3018. ALTERNATING CURRENT SYSTEMS IN METAL ENCLOSURES.

The last sentence of this Code Section has been reworded as follows:

3018. ALTERNATING - CURRENT SYSTEMS IN METAL ENCLOSURES.


ABCN
ABCN
Each enclosure shall contain a) each phase conductor, and b) the neutral, conductor, if one is used
Capacity of circuit requires more than one enclosure
Conductors of equal size, length, etc., are installed - see Section 3105

"If the capacity of a circuit is such that it is impracticable to run all conductors in one enclosure, the circuit may be divided and two or more enclosures may be used provided each phase conductor of the circuit and the neutral conductor, if one is used, are installed in each enclosure. The conductors of such an installation can conform to the provisions of Section 3105 for multiple conductors."

This rewording clarifies a question which has arisen several times in the past and while the intent may have been clear to many, some wiremen did not find this to be true. As a result, costly errors were made and the present rule was criticized for lack of clarity. The errors usually involved the use of the neutral grounded conductor. The new wording should eliminate any confusion in this respect. A common example of the use of this rule would be a three phase, 4 wire service, wye connected which comprises 2–500,000 CM conductors per phase and 1–500,000 CM neutral. If such a combination were placed in two conduits, the conductors must be arranged so that each phase conductor and a neutral conductor must be placed in each conduit.

ARTICLE 310—CONDUCTORS.

Section 3102. CONDUCTOR INSULATION.

This Section contains a Table which lists the various types of conductors and some of their characteristics, which are suitable for use with any of the wiring methods, recognized in Chapter 3. The following new types of conductors have been added to this Table:

1.–Heat Resistant Latex Rubber-Type RUH-75° C–General use.

2.–Moisture and Heat Resistant Rubber, Type RH-RW, 60° and 75° C. This type is recognized for general use, also in a wet location at a maximum operating temperature of 60° C and for general use at 75° C. As a result a No. 1 RH-RW conductor would have a carrying capacity of 110 amperes when used in a wet location and 130 amperes when used generally in dry locations.

3.–Moisture and Heat Resistant Rubber Type RHW–75° C. This type is approved for general use and wet locations with a maximum operating temperature of 75° C. There is no penalty for use in wet locations as is the case with type RH-RW. This is covered by a new note following Tables 1 and 2. (Note 4A).

4.–Mineral Insulation. 85° C. This insulation is approved for general use and wet locations with Type 0 terminal

fillings. Maximum operating temperature for special application 250° C. See Article 330. In addition to the above, the first six items in this Table have been deleted and replaced. The old type letters RF-64, RF-32, FF-64, FF-32, RUF and RUFF have been replaced as follows:

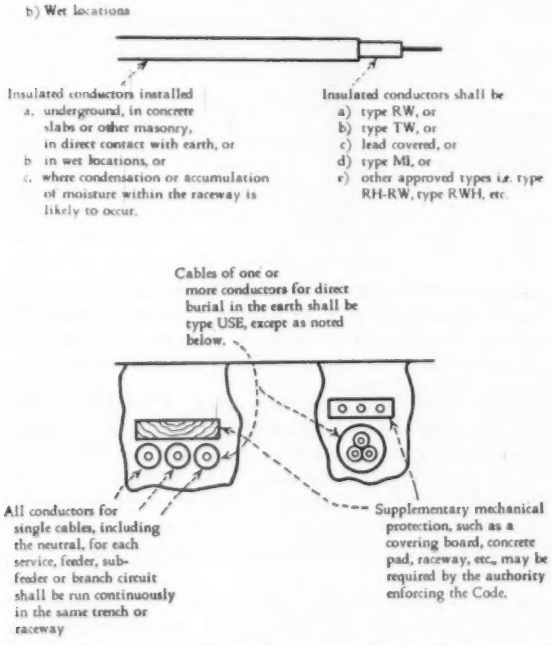
RF 64—RF 1
RF 32—RF 2
FF 64—FF 1
FF 32—FF 2
RUF—eliminated
RUFF—no replacement

Latex rubber, types **RUF and RUFF**, is now recognized under the new designations. Full details are given under Section 93101-e. Four new designations for fixture conductors are recognized as follows: **RFH 1 and 2, FFH 1** and 2 are new 75° C conductors. This new addition is significant since we now have heat resistant fixture conductors rated at 75° C. These new designs narrow the gap which now exists between the 60° C conductor and the 90° heat resisting fixture wire. Several applications are open for its use. See Section 93101-e.

Section 3102-b. WET LOCATIONS.

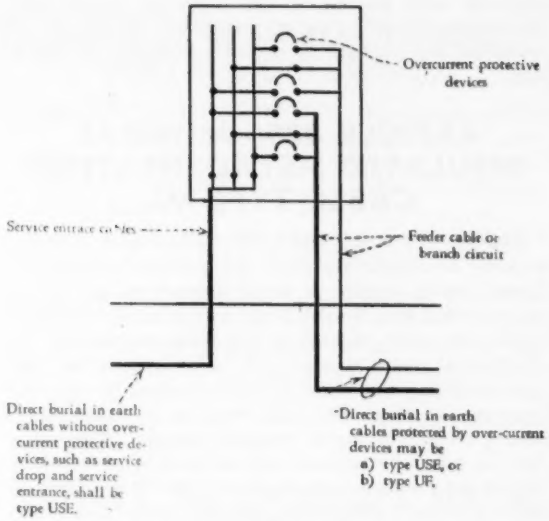
The first paragraph remains as now except for reference to mineral insulated metal sheathed conductors which are also recognized for use in wet locations.

A new paragraph has been added which reads as follows: "Cables of one or more conductors for direct burial in the earth shall be type **USE**, except that


b) Wet locations
Insulated conductors installed
a. underground, in concrete slabs or other masonry, in direct contact with earth, or
b in wet locations, or
c. where condensation or accumulation of moisture within the raceway is likely to occur.
Insulated conductors shall be
a) type RW, or
b) type TW, or
c) lead covered, or
d) type MI, or
e) other approved types i.e. type RH-RW, type RWH, etc.
Cables of one or more conductors for direct burial in the earth shall be type USE, except as noted below.
All conductors for single cables, including the neutral, for each service, feeder, sub-feeder or branch circuit shall be run continuously in the same trench or raceway
Supplementary mechanical protection, such as a covering board, concrete pad, raceway, etc., may be required by the authority enforcing the Code.

branch circuit and feeder cable may be type UF. If single conductor cables are installed, all conductors of each service, feeder, sub feeder or branch circuit, including the neutral conductor, shall be run continuously in the same trench or raceway. Supplementary mechanical protection, such as a covering board, concrete pad, raceway, etc. may be required by the authority enforcing the Code."

COMMENT: This new provision recognizes Type **USE** cable for direct burial. Such procedure has been approved by Underwriters' Laboratories and Inspection authorities for many years. However, the question of single conductor cables is clarified with respect to their status as a cable and also their arrangement in trenches or raceways. The question of mechanical protection is briefly covered by suggestions which may or may not be required by the Inspection authority depending on the field conditions involved. Details concerning the new Type UF cables will be found under the new Article 339 and 93391.


Overcurrent protective devices
Service entrance cables
Feeder cable or branch circuit
Direct burial in earth cables without over-current protective devices, such as service drop and service entrance, shall be type USE.
Direct burial in earth cables protected by over-current devices may be
a) type USE, or
b) type UF.

Section 3105. CONDUCTORS IN MULTIPLE.

The second and third sentence of the present text which specify in number and size of conductors that may be run in multiple and the special permission clause have been deleted. A new fine print note has been added as follows: "When conductors are used in multiple, space in enclosures should be given consideration."

As a result of these changes, there remains no limitation on the number of conductors which may be run in multiple. The current carrying capacity penalty for the number of conductors in a raceway should influence field practice in this regard. The old first sentence which permits conductors in sizes of 1/0 to 500,000 inclusive to be run in multiple remains. The wording however is such that a question might arise concerning the status of conductors smaller than 1/0 or larger than 500,000.

ARTICLE 334—ARMORED CABLE.

Section 3342. USE. The second sentence of this Section has been revised to clarify the use of Type AVC when used at voltages over 600 as recognized under Section No. 7105 and 7121. The present provisions under Section 3342 indicate that this type cable is limited in size to No. 4 and larger. The new wording makes an exception when AVC cables are approved for use at over 600 volts. No minimum wire size is specified.

The fourth sentence of this Section which now reads: "Armored Cable may be run or fished in the air voids of *concrete* masonry block or tile walls where such walls are not exposed to excessive moisture or dampness", has been changed as follows: The word concrete has been deleted and the following words have been added "but not below grade line". The new provision recognizes

armored cable for use in the air voids of any type of masonry block if they are not below grade line and otherwise not exposed to excessive moisture or dampness.

ARTICLE 330—MINERAL INSULATED METAL SHEATHED CABLE TYPE MI.

This is a new article which covers a new form of wiring material in a cable assembly. The product is a self-contained wiring system in which conductors are spaced and insulated by a densely compressed mineral insulation, magnesium oxide, encased in a seamless copper tube. At all terminal points an approved seal is provided in addition to sealing compound, laminated phenolic cap, and neoprene sleeving. The seal shall be provided immediately after stripping to prevent entrance of moisture into the mineral insulation and the conductors extending beyond the sheath shall be insulated with an approved insulating material such as the neoprene mentioned above. The maximum operating temperature for special applications is 250° C. For general use in dry or wet locations with type O terminal fittings the maximum operating temperature is 85°C. The difference in rating is due to the end termination. The application is limited to 600 volts.

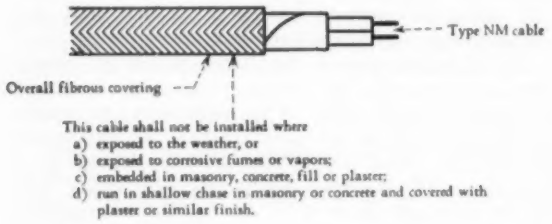
This new wiring method is approved for use for services, feeders, and branch circuits in both exposed and concealed work, in dry or wet locations; for under plaster extensions as provided in article 344; and embedded in plaster finish on brick or other masonry. It may be used where exposed to weather or continuous moisture, for underground runs and embedded in masonry, concrete or fill, in buildings in course of construction or where exposed to oil, gasoline, or other conditions not having a deteriorating effect on the metal sheath. The sheath of mineral insulated-metal sheathed cable exposed to destructive corrosive conditions, such as some types of cinder fill, shall be protected by materials suitable for those conditions.

In order to assure good workmanship with respect to the installation of terminating seals the committee found it necessary to require the completed wiring system to be tested for insulation resistance in accordance with Section 1119. Its use in Hazardous Locations is now under investigation by Underwriters' Laboratories.

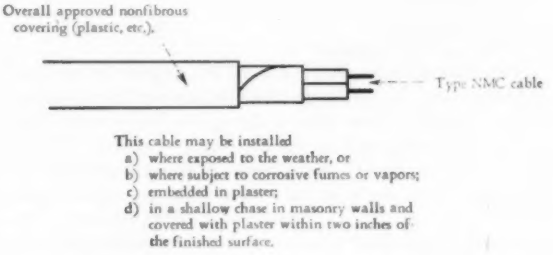
ARTICLE 336—NON-METALLIC SHEATHED CABLE.

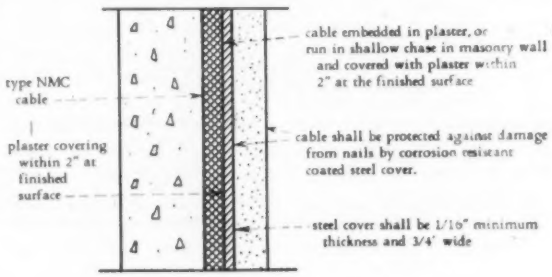
Section 3362. USE. This Section has been rewritten to provide for two types of cable as follows:

a. Type NM—This type of cable is suitable for use for general wiring in normally dry locations and in the hollow spaces of masonry walls where not subject to excessive moisture or dampness. This type includes the generally well known fibrous covered cable.


Type NM cable
Overall fibrous covering
This cable shall not be installed where
a) exposed to the weather, or
b) exposed to corrosive fumes or vapors;
c) embedded in masonry, concrete, fill or plaster;
d) run in shallow chase in masonry or concrete and covered with plaster or similar finish.

b. Type NMC. Under this classification, we now have special recognition and extended use for the thermoplastic and neoprene jacketed cables which are considered suitable for use in corrosive locations and dry, moist or damp locations, including inside and exterior masonry block walls, above or below grade line, where excessive moisture may occur periodically. This type of cable is not permitted in wet locations as defined in Article 100, however it is not intended to prohibit the use of the new type UF cable covered by Article 339, when used for interior wiring under Article 336, in such wet locations. Type NMC cable may be embedded in plaster or run in a shallow chase in masonry walls and covered with plaster within 2 inches of the finished surface provided it is protected against damage from nails by a cover of corrosion-resistant coated steel at least ¼ inch in thickness and ¾ inch wide in the chase or under the final surface.


Overall approved nonfibrous covering (plastic, etc.).
Type NMC cable
This cable may be installed
a) where exposed to the weather, or
b) where subject to corrosive fumes or vapors;
c) embedded in plaster;
d) in a shallow chase in masonry walls and covered with plaster within two inches of the finished surface.


type NMC cable
plaster covering within 2" at finished surface
cable embedded in plaster, or run in shallow chase in masonry wall and covered with plaster within 2" at the finished surface
cable shall be protected against damage from nails by corrosion resistant coated steel cover.
steel cover shall be 1/16" minimum thickness and 3/4" wide

c. **USES NOT PERMISSIBLE FOR EITHER TYPE NM OR NMC NON-METALLIC SHEATHED CABLE.** These types shall not be used as (1) service-entrance cable, (2) in commercial garages, (3) in theatres except as provided in Section 5211, (4) in motion picture studios, (5) in storage battery rooms, (6) in hoistways, (7) in any hazardous location, (8) embedded in poured cement, concrete or aggregate.

It is significant to note that the old No. 7 restriction, covering breweries, ice plants, cold storage warehouses etc., has been deleted due to the fact that the new Type NMC cables are considered suitable for such use.

The old fine print note which reads as follows also has been deleted: "Some dairy barns, chicken houses, and similar locations may be considered wet locations and subject to corrosive fumes and vapors, in which event a non-metallic sheathed cable specifically approved for the purpose should be used."

As the matter now stands, the authority enforcing the Code must determine if such occupancies are wet locations and subject to corrosives fumes and vapors. In the event

they are considered to be so, Type NMC or Type UF cable must be used.

A principal factor involved with the development of Types NMC and UF cables and these new Code provisions was the field experience, especially in farm occupancies in the North Central part of our country which clearly indicated that the fibrous covered cable now recognized by the Code would not stand up under the severe climate conditions encountered. Temperature changes resulting in condensation together with the corrosive atmospheres common to many cattle barns promoted many cable failures. As a result of such unfavorable field experience, all interested parties cooperated in the development of a type of cable that could cope with such conditions, and the new Type NMC cable is the Code answer to the problem presented.

ARTICLE 339 — UNDERGROUND FEEDER AND BRANCH CIRCUIT CABLE TYPE UF.

Section 3391. SCOPE. Installations of underground feeder and branch circuit cable (Type UF) shall comply with the provisions of Section 3001 and 3020 inclusive, paragraph b of Section 3102, and in addition shall conform with provisions of Section 3392.

Section 3392. USE. Underground feeder and branch circuit cable may be used underground, including direct burial in the earth, as feeder or branch circuit cable when provided with overcurrent protection not, in excess of the rated current carrying capacity of the individual conductors. If single conductor cables are installed, all cables of the feeder circuit, sub-feeder circuit or branch circuit, including the neutral conductor, if any, shall be run together in the same trench of raceway. If buried directly in the earth, supplementary mechanical protection, such as a covering board, concrete pad, raceway, etc. when considered necessary, may be required by the authority enforcing the Code. Multiple conductor type UF cable may also be used for interior wiring when complying with the provisions of Article 336 and may be used in wet locations.

This is a new Code Article which extends the recognition of the use of cables for direct burial in the ground from that now recognized for service use, Type USE, to feeders and branch circuits Type UF. In the first case, practically speaking, unprotected by overcurrent devices. In the second case, they are protected. Since such cables do not have inherent protection from mechanical injury, it is important that the Code provision in this respect be carefully considered. As already mentioned in the previous Article, Type UF cable may be used for interior wiring and wet locations as defined in Article 100. The definition of a "wet location" includes exposure to the weather and direct burial in the earth.

ARTICLE 338 — SERVICE ENTRANCE CABLE.

Section 3382. USE. The new provision in this Section permits the use of a service entrance cable, without individual insulation on the grounded conductor, to be used for wiring to a clothes dryer. According to the present Code, ranges and water heaters may be so wired. A similar provision is covered under Section 2560.

ARTICLE 348—ELECTRICAL METALLIC TUBING.

Section 3464. WET LOCATIONS. A new paragraph has been added which reads as follows: "All supports, belts, straps, screws, etc. shall be of corrosive-resistant materials or protected against corrosion by approved corrosion-resistant materials."

The same provision also applies to electrical metallic tubing used in wet locations. (Section 3484)

Section 3466. NUMBER OF CONDUCTORS IN RACEWAY. This Section has been revised in order to clarify the number of conductors permitted in conduit or tubing when new work is involved or for rewiring in existing raceways. It appears that this clarification will be welcomed by many since the present provisions have been the source of dispute in the past.

ARTICLE 350—FLEXIBLE METAL CONDUIT.

Section 3503. MINIMUM SIZE. At the present time the Code recognizes the use of 3/8" flexible metal conduit but there are no provisions covering the number of conductors that may be installed. The new Code covers this question by a new Table which lists the maximum number of conductors permitted in line with their size and insulation.

ARTICLE 353—MULTI-OUTLET ASSEMBLY.

This new Code article reads as follows:

Section 3531. SCOPE. Installations of multi-outlet assembly shall comply with applicable provisions of Sections 3001 to 3020 inclusive and in addition shall comply with the provisions of the following Section 3532.

Section 3532. USE. Multi-outlet assembly may be used in dry locations. It shall not be used (1) where concealed, except that the back and sides of metal multi-outlet assembly may be surrounded by the building finish and non-metallic multi-outlet assembly may be recessed in the baseboard; (2) where subject to severe mechanical injury unless approved for the purpose; (3) where the voltage is 300 volts or more between conductors unless assembly is of metal having a thickness of not less than .040 inches; (4) where subject to corrosive vapors; (5) in hoistways; (6) in storage battery rooms; nor (7) in any hazardous locations. Multi-outlet assembly shall not be extended through walls, partitions or floors.

The Committee felt that the increased use of this material coupled with new designs warranted Code recognition of such materials in a separate Article. It also clarifies the position of multi-outlet assemblies with respect to other surface raceways. At the present time, such assemblies are covered by Article 352, Surface Metal Raceways. The introduction of non-metallic assemblies was also a main factor in consideration of the new Article.

ARTICLE 362—WIREWAYS.

Section 3622. USE. The first sentence has been amended to read "Wireways may be used only for exposed work in dry locations."

This change is significant since the present Code restricts the use of this wiring method to industrial occupancies, garages and theaters. The new provision eliminates any restriction as to occupancy except as is now covered for hoistways, hazardous locations and storage-battery rooms.

Section 3625. SPLICES AND TAPS. The present Code requires splices or taps located within the wireway to be accessible by the use of hinged covers. This provision has been deleted which could result in the use of screw-attached covers or other methods affording access.

ARTICLE 364—BUSWAYS.

Section 3642. USE. The word "only" has been added to the first sentence which now reads: "Busways may be used *only* for exposed work." This is significant since the present wording permits busways to be used for exposed work and leaves a question regarding its status for concealed work. Such rules often lead to confusion and dispute. The new wording is definite and the Inspector and Contractors know where they stand.

ARTICLE 370—OUTLET, SWITCH AND JUNCTION BOXES AND FITTINGS.

Section 3709. NUMBER OF CONDUCTORS IN A BOX. In the Table following paragraph a of sections 3709 insert a reference to: a 4 inch x 1¼ inch box to allow nine No. 14 AWG conductors, six No. 10 AWG, seven No. 12 AWG and four No. 8 AWG conductors to be installed.

This extension eliminates the necessity for computing the number of conductors permitted, in this size box, on the basis of the cubic inch requirement covered by Section 3709-b.

ARTICLE 384—PANELBOARDS.

Section 3880 GENERAL. All panelboards shall have a rating not less than the minimum feeder capacity for the load connected to the panelboard as computed from Article 220.

This is a new general provision covering the rating of a panelboard and should clarify the various questions which have arisen in the past.

Section 3881. LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARD.

For the purpose of this Section, a lighting and appliance branch circuit panelboard is one having more than 10% of its overcurrent devices rated 30 amperes or less, for which neutral connections are provided.

This is a new Code provision which will clarify the many controversies which have arisen in the past concerning the meaning of the term "lighting and appliance branch circuit." The present Section 3881 still remains as now under Section 3882.

Section 3883. OVERCURRENT PROTECTION. This section which now appears under Section 3882 has been revised with the following results: According to the present Code, any panelboard supplied by conductors having overcurrent protection greater than 200 amperes shall be protected on the supply side by overcurrent devices having a rating not greater than that of the panelboard. The new wording limits this provision to apply only to "a lighting and appliance branch circuit panelboard". This is a significant change.

Another new important provision has been added to this Section. It reads as follows:

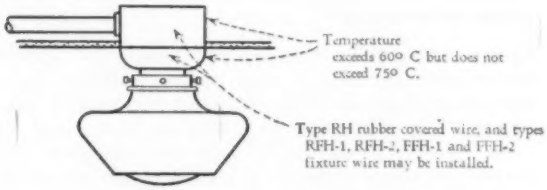
"The overcurrent protective devices of all panelboards installed in industrial or commercial buildings where loads continue for long periods of time, shall have a rating not less than 125% of the circuit loading, as determined by Articles 210 and 220."

Present Sections 3883, 3884 and 3885 continue as now, renumbered 3884, 3885, and 3886.

ARTICLE 400—FLEXIBLE CORDS.

Section 4005 and 4007. At the present time, both of these Sections recognize the use of types SU and SUO cords, both of which involve the use of latex rubber. These types of cord are deleted in the Code and the latex rubber cords are now grouped with other rubber cords under the designations S and SO. This change is similar to that already covered under Section 3102 where fixture wires type RUF and RUFF were grouped under the general designations for rubber covered fixture wires.

4144. CONDUCTORS FOR SPECIAL CONDITIONS
Exception No. 3


Temperature exceeds 600 C but does not exceed 750 C.
Type RH rubber covered wire, and types RFH-1, RFH-2, FFH-1 and FFH-2 fixture wire may be installed.

Section 4010. THIS IS NEW AND VERY SIGNIFICANT. ATTACHED TO RECEPTACLE PLUGS. Where a flexible cord is provided with a grounding conductor and equipped with an attachment plug, the plug shall comply with section 2559.a. and 2559.b. unless accepted elsewhere in this Code.

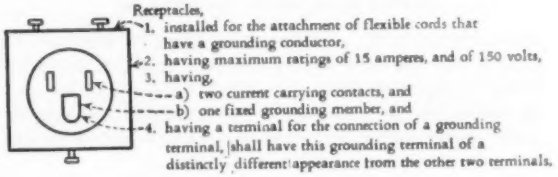
Also, add a fine print note to this section to read:

This requirement becomes effective January 1, 1955.

This new provision is in line with the objective of Article 250 to obtain properly designed receptacles and plugs so arranged that the grounding terminal is readily identified and the possibility of polarity reversal is minimized. The delayed effective date, about one year, undoubtedly is warranted in fairness to manufacturers and other parties concerned.

Two new Sections 4164 and 4165 have been added. They concern the new grounding type receptacles and attachment plug caps, and questions of design covering a more definite identification of the terminal for the connection of the grounding conductor and the question of the plug cap grounding member making contact with the current carrying contacts of the receptacle are covered. This again is another step in the development of

4164. RECEPTACLES-GROUNDING TYPE.


Receptacles,
1. installed for the attachment of flexible cords that have a grounding conductor,
2. having maximum ratings of 15 amperes, and of 150 volts,
3. having,
a) two current carrying contacts, and
b) one fixed grounding member, and
4. having a terminal for the connection of a grounding terminal, shall have this grounding terminal of a distinctly different appearance from the other two terminals.

the grounding type of receptacles and plug caps, use for grounding portable equipment, in the interests of safety especially from the personal injury hazard.

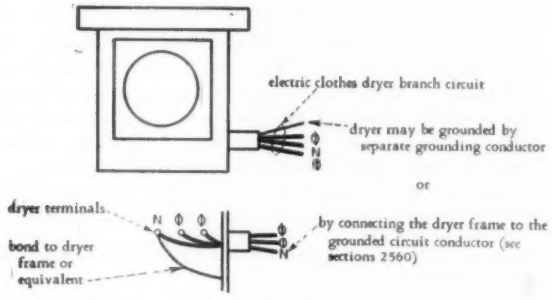
Section 4194. TRANSFORMER RATINGS. The last two sentences have been rewritten to clarify the point that the current ratings of 120 and 240 milli-amperes are for open circuit voltages, in the first case over 7500 volts, and in the second case when the open circuit voltage is 7500 or less.

Section 4215. FIXTURES, LAMPHOLDERS AND RECEPTACLE PLATES NEAR GROUNDED SURFACES. The first sentence of this section has been changed to read as follows: "Ungrounded metal lighting fixtures, lampholders and face plates shall not be installed *in contact with conducting surfaces nor* within 8' vertically etc." The words in italics represent the change.

PANEL COMMENT: There is evidently a need for regulation to prohibit the installation of fixtures (and outlet boxes) in contact with such conducting surfaces as conductive thermal insulations. Code Making Panel No. 10 recommends that Code Making Panel No. 9 consider a similar regulation in Section 3704 so that boxes would not be in contact with conducting surfaces.

Section 4310. LOCATION OF MOTORS. The first sentence of this Section has been extended to recognize ventilation. The new clause reads: "Motors shall be located so that adequate ventilation is provided."

Section 4322. MOTOR OVERCURRENT PROTECTION. CONTINUOUS DUTY MOTORS. 4322 a-1. A new sentence has been added as follows: "For other than sealed (hermetic type) refrigeration compression motors this value may be modified as permitted by Section 4323."


electric clothes dryer branch circuit
dryer may be grounded by separate grounding conductor
N
Φ
Φ
or
dryer terminals
N Φ Φ
bond to dryer frame or equivalent
by connecting the dryer frame to the grounded circuit conductor (see sections 2560)

SECTION 4362—MOTOR-FEEDER OVERCURRENT PROTECTION. RATING OR SETTING — MOTOR LOAD.

This Section has been revised to read as follows: "A feeder which supplies a specific fixed motor load and consisting of conductor sizes based on section 4314 shall be provided with overcurrent protection which shall not be greater than the largest rating or setting of the branch-circuit protective device, for any motor of the group (based on Tables 26 and 27, Chapter 10), plus the sum of the full-load currents of the other motors of the group. For large capacity installations, where heavy capacity feeders are installed to provide for future additions or changes, the feeder overcurrent protection may be based on the rated current-carrying capacity of the feeder conductors."

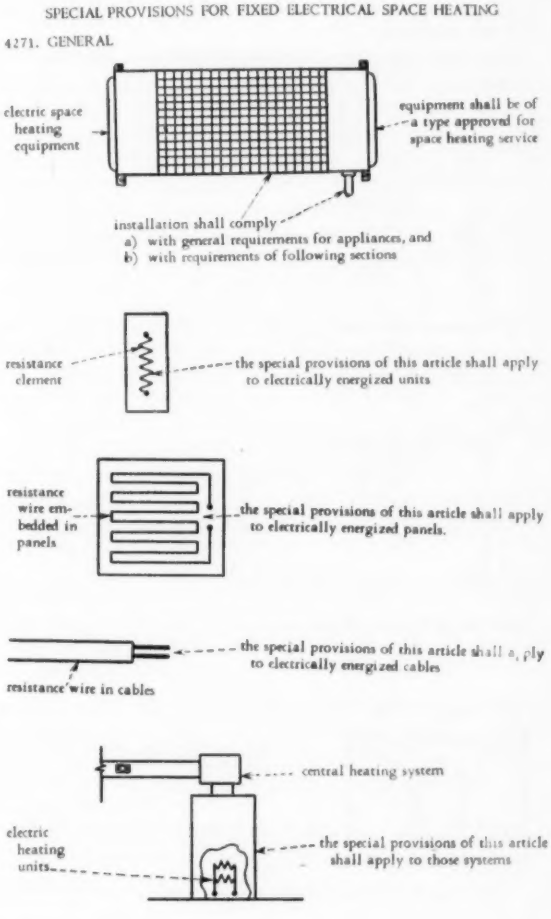
The fine print notes remain as at present.

The first sentence is similar to the present Code. The second sentence is a significant change since it intends to satisfy the request of the sponsor who made the following suggestion: "Suggest that Section 4362 be modified so that it will not be necessary to change the circuit breaker on a feeder when a change is made in the horsepower rating of the motor supplied by the feeder".

ARTICLE 422 APPLIANCES—Special Provisions for Fixed Electrical Space Heating.

The Scope of Article 422 has been expanded to cover "Fixed Electrical Space Heating". Sections 4271 to 4286 inclusive cover the subject and are new Code provisions. I believe all of us who have faced the problem of electrical space heating during the past several years with very little guidance from the Code will welcome these new provisions.

Section 4271. GENERAL. This Section requires equipment for use with electrical space heating to be of a type approved for such service. The Underwriters' Laboratories list several radiant heating equipments for use


SPECIAL PROVISIONS FOR FIXED ELECTRICAL SPACE HEATING
4271. GENERAL
electric space heating equipment
equipment shall be of a type approvd for space heating service
installation shall comply
a) with general requirements for appliances, and
b) with requirements of following sections
resistance element
the special provisions of this article shall apply to electrically energized units
resistance wire embedded in panels
the special provisions of this article shall apply to electrically energized panels.
the special provisions of this article shall apply to electrically energized cables
resistance wire in cables
central heating system
electric heating units
the special provisions of this article shall apply to those systems

where the operating temperatures on the heated surfaces are limited to 150 degrees F. maximum. Such systems usually involve panel, cable units or radiant heating units. U. L. also lists several fixed air heaters of the circulating-fan, wall insert, and surface mounting types which also are suitable.

This Section also requires quote "The special provisions of this Article shall apply to electrically energized units, panels and cables for space heating. They shall also include central heating systems employing electrical heating units."

In view of the general interest and the increasing use of this method of heating, we are quoting all the Code provisions.

GENERAL. Equipment for use with electrical space heating systems shall be of a type approved for such service. In addition to complying with the general requirements for appliances, such equipment shall comply with sections 4271 to 4286 inclusive.

The special provisions of this Article shall apply to electrically energized units, panels and cables for space heating. They shall also include central heating systems employing electrical heating units.

Electrical space heating systems employing methods of installation other than covered by sections 4271 to 4286 inclusive may be used only by special permission.

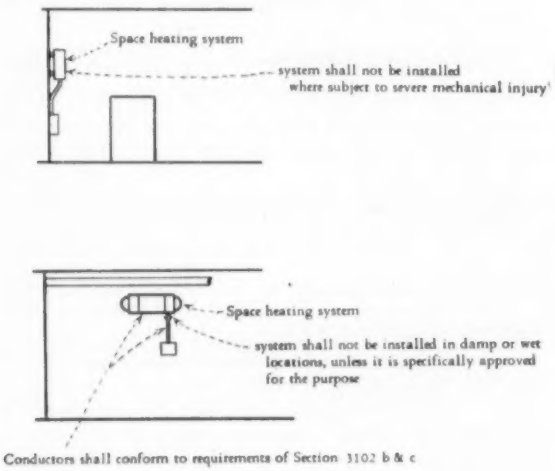
Section 4272. USE. Space heating systems shall not be used

(1) where exposed to severe mechanical injury unless adequately protected.

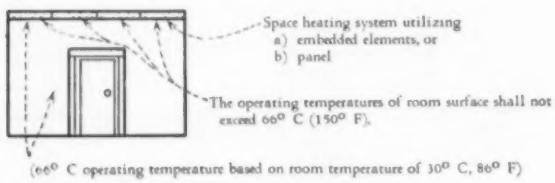
(2) in wet or damp locations unless specially approved for the purpose.

See also rules on Corrosive Conditions, Section 3102 b and c.

4272. USE.


Space heating system
system shall not be installed where subject to severe mechanical injury
Space heating system
system shall not be installed in damp or wet locations, unless it is specifically approved for the purpose
Conductors shall conform to requirements of Section 3102 b & c

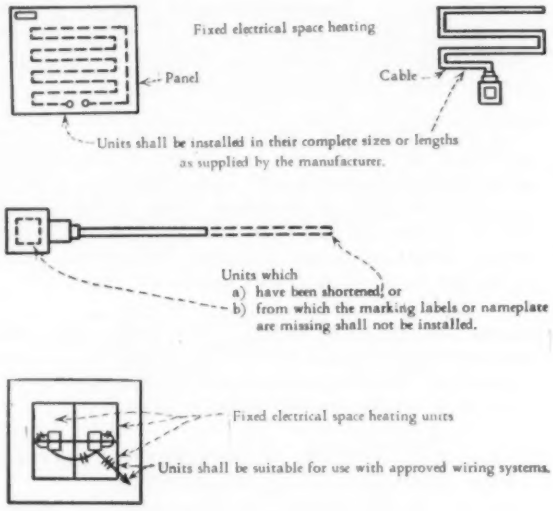
4273. TEMPERATURE LIMITATIONS.


Space heating system utilizing
a) embedded elements, or
b) panel
The operating temperatures of room surface shall not exceed 66° C (150° F).
(66° C operating temperature based on room temperature of 30° C, 86° F)

Section 4273. TEMPERATURE LIMITATIONS. The operating temperature of room surfaces where embedded elements and panels are used shall not exceed 66°C. (150°F.). (Based on room temperature of 30°C., 86°F.)

Section 4274. APPLIANCES TO BE COMPLETE UNITS. Panels and cables shall be installed in their complete sizes or lengths as supplied by the manufacturer. Units which are shortened or from which the marking labels or nameplates are missing shall not be installed. Units shall be suitable for use with approved wiring systems.

4274. APPLIANCE TO BE COMPLETE UNIT


Fixed electrical space heating
Panel
Cable
Units shall be installed in their complete sizes or lengths as supplied by the manufacturer.
Units which
a) have been shortened, or
b) from which the marking labels or nameplate are missing shall not be installed.
Fixed electrical space heating units
Units shall be suitable for use with approved wiring systems.

Section 4275. CONSTRUCTION. Heating cables shall be furnished complete with factory-assembled non-heating leads at least 7 feet in length, and the leads shall consist of conductors and wiring approved for general use.

Section 4276. MARKING OF HEATING CABLES. Each unit length of heating cable shall have a permanent marking located within 3 inches of the terminal end of the non-heating leads, and shall be legibly marked with the manufacturer's name or identification symbol, catalog number, and rating in volts and watts or amperes.

The lead wires shall have the following color identifications: 230 volts nominal-red, 115 volts nominal-yellow.

Section 4277. CONTROLLERS AND DISCONNECTING MEANS.

a. Thermostats and thermostatically controlled switching devices which indicate an "off" position and which interrupt line circuit shall open simultaneously all ungrounded conductors in the "off" position.

b. Thermostats and thermostatically controlled switching devices which do not have "on" or "off" positions are not required to open all ungrounded conductors.

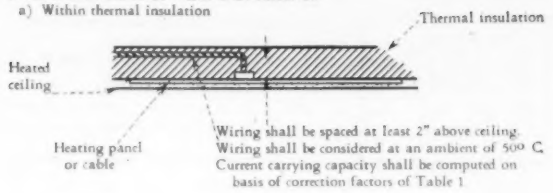
See Sections 4241, 4241-b and 4241-d for disconnecting means for stationary appliances.

Section 4278. CLEARANCES OF WIRING IN CEILINGS.

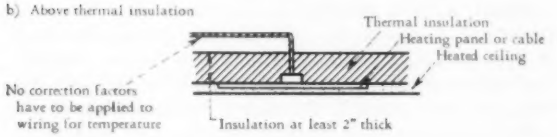
a. Wiring located above heated ceilings and within thermal insulation shall be spaced not less than 2 inches above the heated ceiling and shall be considered as operating at an ambient of 50°C. The current carrying ca-

4278. CLEARANCES OF WIRING IN CEILINGS

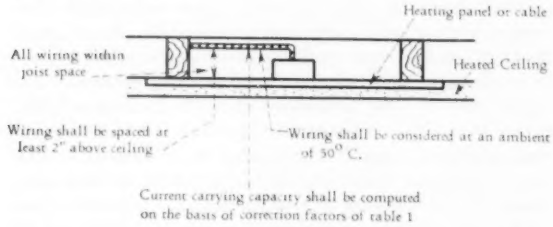
a) Within thermal insulation


Thermal insulation
Heated ceiling
Heating panel or cable
Wiring shall be spaced at least 2" above ceiling.
Wiring shall be considered at an ambient of 50° C.
Current carrying capacity shall be computed on basis of correction factors of Table 1

b) Above thermal insulation


Thermal insulation
Heating panel or cable
Heated ceiling
No correction factors have to be applied to wiring for temperature
Insulation at least 2" thick

c) Above heated ceiling


Heating panel or cable
All wiring within joist space
Heated Ceiling
Wiring shall be spaced at least 2" above ceiling
Wiring shall be considered at an ambient of 50° C.
Current carrying capacity shall be computed on the basis of correction factors of table 1

pacities of conductors shall be computed on the basis of the correction factor given in Table 1, Chapter 10.

b. Wiring located above heated ceilings and over thermal insulation having a minimum thickness of 2 inches requires no correction for temperature.

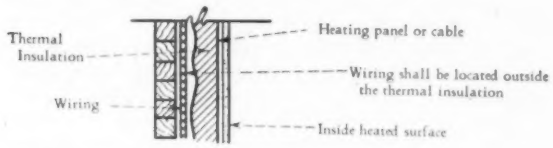
c. Wiring located above heated ceilings and within a joist space having no thermal insulation shall be spaced not less than two inches above the ceiling and shall be considered as operating at an ambient of 50° C. The current carrying capacities of conductors shall be computed on the basis of the correction factor given in Table 1, Chapter 10.

Section 4279. CLEARANCES OF WIRING IN WALLS.

a. Where located in exterior walls, wiring shall be located outside the thermal insulation.

4279. CLEARANCES OF WIRING IN WALLS

a) Exterior walls



b. Where located in interior walls or partitions, wiring shall be located away from the heated surfaces, and the wiring shall be considered as operating at an ambient of 40°C. (104°F.); and the current carrying capacities of conductors shall be computed on the basis of the correction factors of Table 1, Chapter 10.

Section 4280. CONFINEMENT IN ONE ROOM. Panels shall not extend beyond the room in which they originate. Cables shall not be installed in closets, over cabinets which extend to the ceiling, under walls or partitions or over walls or partitions which extend to the ceiling, except that single runs of cable may pass over partitions where embedded. This requirement shall not prohibit low-temperature heat sources in closets to control relative humidity.

Section 4281. CLEARANCE FROM OTHER OBJECTS AND OPENINGS. Panels and cables shall be separated at least 8 inches from lighting fixtures, outlet and junction boxes, and 2 inches from ventilating openings and other such openings in room surfaces, or sufficient area shall be provided to assure that no heating cables or panels will be covered by surface mounted lighting units.

Section 4282. SPLICES. Embedded cables may be spliced only where necessary and only by approved means, and in no case shall the length of the heating cable be altered.

Section 4283. INSTALLATIONS OF HEATING CABLES IN PLASTER.

a. Cables shall not be installed in walls.

b. Adjacent runs of cable not exceeding 2¾ watts per foot shall be installed not less than 1½ inches on centers.

c. Heating cables may be applied only to gypsum board, plaster lath and similar fire-resistant materials. With metal lath or other conducting surfaces, a coat of plaster (brown or scratch coat) shall be applied to completely cover the metal lath or conducting surface before the cable is attached.

d. The entire ceiling surface shall have a finish of thermally non-insulating plaster or of other approved material having a nominal thickness of ½-inch.

e. Cables shall be secured at intervals not exceeding 16 inches by means of approved stapling, tape, plaster or other approved means. Staples or metal fasteners which straddle the cable shall not be used with metal lath or other conducting surface.

f. Cables shall be kept free from contact with metal or conducting surfaces.

Section 4284. INSTALLATION OF NON-HEATING LEADS. Non-heating leads of cables shall be installed in accordance with approved wiring methods from the junction box to a location on the underside of the ceiling. Excess leads shall not be cut but shall be secured to the underside of the ceiling and embedded in plaster or other approved material, leaving only a length sufficient to reach the junction box with not less than 6 inches of free lead within the box. The marking of the leads shall be visible in the junction box.

Section 4285. INSTALLATION OF CABLES IN CONCRETE OR POURED MASONRY FLOORS.

a. Adjacent runs of cable not exceeding 2¾ watts per foot shall be installed not less than 1 inch on centers.

b. Cables shall be secured in place by non-metallic frames or spreaders while the concrete or other finish is applied.

c. A spacing of at least 1 inch shall be maintained between the heating cable and other metallic bodies embedded in the floor.

d. Leads shall be protected where they leave the floor by rigid metal conduit, electrical metallic tubing, or by other approved raceways extending to the junction box.

e. Bushings shall be used where the leads emerge in the floor slab.

Section 4286. TESTS DURING AND AFTER INSTALLATION. Embedded cable installations shall be made with due care to prevent damage to the cable assembly and shall be inspected and approved before cables are covered or concealed.

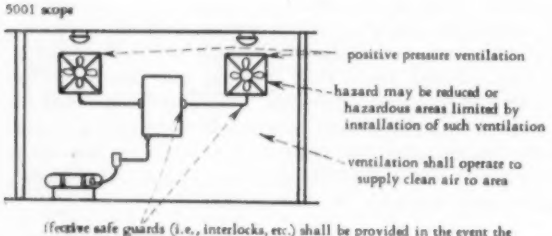
Cable shall be tested for insulation resistance after plastering or the pouring of floors. See Section 1119, Insulation Resistance.

PERSONAL COMMENT. The question of computing feeder sizes for such loads is covered by Section 2203-h and we refer you to that Section for the details. It appears that a reference should be made under Section 4271 to this important feature of space heating covered by Section 2203-h. Section 4278 is also important since it covers definite requirements for conductors exposed to ambient temperatures in excess of 30° C. As an example, a No. 12 R conductor exposed to temperatures as covered by Section 4278-a-c would have a carrying capacity of 58% x 20 A = 11.6 Amps., or a No. 14 conductor would be rated 58% x 15 A = 8.7 Amps. This is significant. A similar provision applies to wiring in walls. In this case the correction factor would be 82%. Section 4281 is also important. The provision covered by Section 4286 calling for an insulation resistance test applies only to embedded cable installations.

ARTICLE 500—HAZARDOUS LOCATIONS.

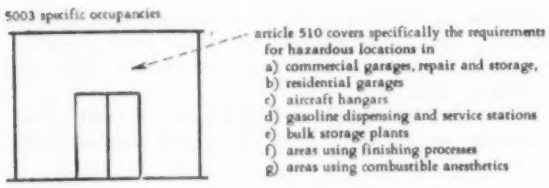
In view of the numerous changes made in this Article, it is impractical to present all the details involved in a presentation of this nature. We shall therefore endeavor to cover the important changes involved in a general manner.

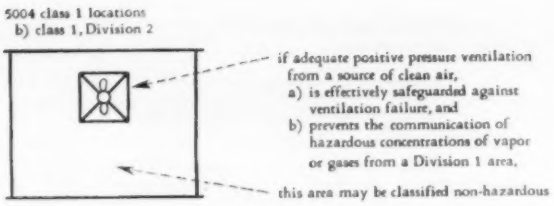
The principle of "positive-pressure ventilation from a source of clean air in conjunction with effective safeguards against ventilation failure" is recognized as a means of reducing the hazard created by the accumulation of hazardous gases or vapors. (Sections 5001 and 5004-b.)


5001 scope
positive pressure ventilation
hazard may be reduced or hazardous areas limited by installation of such ventilation
ventilation shall operate to supply clean air to area
effective safe guards (i.e., interlocks, etc.) shall be provided in the event the ventilation system fails

Under Section 5002 specific references are made to several new atmospheric mixtures such as ethelene, cyclopropane, hexane, benzine, butane, propane and benzol and also dusts including aluminum, magnesium and their commercial alloys, also flour and starch.

Section 5003. Under the old Code this Section covered provisions applicable to paints, lacquers and finishes. All of these provisions have been deleted since they are now covered under Article 510. The new Section 5003 tells us that garages, aircraft hangars, gasoline dispensing stations, bulk storage plants, finishing processes and combustible anesthetics are now covered under Article 510.


5003 specific occupancies
article 510 covers specifically the requirements for hazardous locations in
a) commercial garages, repair and storage,
b) residential garages
c) aircraft hangars
d) gasoline dispensing and service stations
e) bulk storage plants
f) areas using finishing processes
g) areas using combustible anesthetics


5004 class 1 locations
b) class 1, Division 2
if adequate positive pressure ventilation from a source of clean air,
a) is effectively safeguarded against ventilation failure, and
b) prevents the communication of hazardous concentrations of vapor or gases from a Division 1 area,
this area may be classified non-hazardous

Under wiring methods in Section 5014 b, threaded electrical metallic tubing is recognized in a Class 1, Division 2 location. The old rule recognized any type of approved E. M. tubing. Under this Section flexible cord approved for extra hard usage may be used for flexibility in a Class 1, Division 2 location as covered.

Under Section 5015—Sealing. Several new provisions are made to clarify the many controversial questions which have arisen in the past concerning this question. Conduit runs between enclosures not more than 36" long would require only one seal located at not more than 18" from each enclosure. When a conduit run leaves a hazardous location the seal may be located on either side of the boundary of such hazardous area. Ordinary conduit fittings of the "L", "T" or "Cross" type would not usually be classed as enclosures if not larger than the trade size of the conduit. A new provision 5015 c-6 covers assemblies where equipment producing arcs, sparks or high temperatures are located in compartments separate from compartments containing splices or taps. Since the entire assembly must be approved the question of sealing involved with this new provision will rest with Underwriters' Laboratories.

The term "explosion-proof" has been deleted in several sections where enclosures are involved. The term approved for the purpose achieves the same end.

Under Section 5019-a-3. Pendant Fixtures. Such fixtures must not only be supplied through rigid conduit stems but the following new provision also applies: "and threaded joints shall be provided with set-screws or other effective means to prevent loosening."

Under Section 5019-b-2. Fixed lighting fixtures must conform to the new provision which reads as follows: "If lamps of a size or type which may, under normal operating conditions, reach surface temperatures exceeding eighty percent (80%) of the ignition temperature of the gas or vapor involved, as determined by A.S.T.M. test procedure (Designation D 286-30), fixtures shall conform to sub-paragraph a.1. of this Section."

Section 5019-a-1 requires a fixture to be marked to indicate the maximum wattage of lamps for which it is approved.

CLASS 2. INSTALLATION.

Section 5051. GENERAL. A new fine print note has been added which limits it to the status of a recommendation. The nature of the information given however is significant. It reads as follows: A similar note appears under 5071, Class 3 installations.

"Equipment installed in Class 2 locations should be able to function at full rating without developing surface temperatures high enough to cause excessive dehydration or gradual carbonization of any organic dust deposits that may occur. Dust which is carbonized or is excessively dry is highly susceptible to spontaneous ignition. In general, maximum surface temperatures under actual operating conditions should not exceed 165° C. (329° F.)

for equipment which is not subject to overloading, and 120° C. (248° F.) for equipment such as motors, power transformers, etc., which may be overloaded."

SUPPORTING COMMENT: The question of temperature limitations with respect to organic dusts was discussed at some length. It was pointed out that the temperature for immediate ignition of such dusts may be very much higher than temperatures which may lead to ignition after prolonged exposure. Some tests by Underwriters' Laboratories, Inc. made with small dust samples heated on a hot plate indicated no ignition and no evidence of charring after about 16 hours exposure at 165° C. On the other hand, there are numerous cases where materials such as press-cake from soy bean processing and dried distillers' and brewers' grains have ignited spontaneously at temperatures under 120° C. Dust accumulations on steam coils for grain driers have ignited in several cases when steam pressures were about 40 pounds (142° C), and dust accumulations in grain drier columns have ignited frequently when stoppage of grain movement has occurred even though the temperature of the incoming hot air was less than 120° C.

Among engineers and others who are directly concerned with fires and explosions in grain handling and grain processing plants, it is generally recognized that 250° F. (121° C.) is the maximum temperature to which organic materials can be safely exposed over long periods. Among insurance companies interested in grain and milling risks, sustained temperatures above that level are definitely considered to be dangerous.

The development of insulating materials with higher and higher operating temperatures, has reached the point where motors and other equipment with high temperature insulation may operate at surface temperatures which are dangerous in Class 2 locations.

It is believed that the entire subject of ignition temperatures for various organic dusts should be investigated with particular reference to long-time exposure (3 to 6 months). Until this is done, exposure of such dust to temperatures exceeding 121° C. should be looked upon with a great deal of suspicion. Accordingly, it is proposed that the above fine print note be inserted immediately following 5051.

Section 5053. SURGE PROTECTION, CLASS 2, DIVISIONS 1 and 2.

A new sentence has been added to the second fine print note which reads as follows: "For ungrounded secondary systems, secondary lightning protective devices may be provided both at the service and at the point where the secondary system receives its supply, and the intervening secondary conductors may be accepted as the metallic connection between the secondary protective devices, provided grounds for the primary and secondary devices are metallically interconnected at the supply end of the secondary system and the secondary devices are grounded to the raceway system at the load end of the secondary system".

PANEL COMMENT: Some utility companies are reluctant to run an additional overhead conductor to interconnect the ground at the service with the ground for the primary arresters. Under such conditions, secondary arresters at the transformers and at the service equipment can be used to obtain effective surge protection. Accordingly, it is proposed that the above be added to the second paragraph of the fine print note.

Section 5061-b-2. FIXED LIGHTING (Class 2, Division 2 Location)

The old wording has been replaced as follows: "Lighting fixtures for fixed lighting, if not of a type approved for Class 2 locations, shall provide enclosures for lamps and lampholders which shall be designed to minimize the deposit of dust on lamps and to prevent the escape of sparks, burning material or hot metal. Each fixture shall be clearly marked to indicate the maximum wattage of lamp which may be used without exceeding a maximum exposed surface temperature of 165° C. (329° F.) under normal conditions of use.

COMMENT: This change is in accord with the discussion covered under 5051.

A similar provision also appears under 5079-a, covering lighting fixtures in a Class 3 location.

ARTICLE 510– Garages And Similar Occupancies.

According to the 1951 Code, Article 510 covers garages and similar occupancies such as airplane hangars, gasoline service stations, bulk storage plants and other locations where gasoline or other highly volatile motor fuel is stored in vehicles, dispensed, or where service and repair operations are carried on with this type of equipment. The 1953 Code has extended the scope of this Article so that in addition to the above occupancies, finishing processes and combustible anesthetics are now included. As a result, the caption and text of this article has been changed as follows:

ARTICLE 510–SPECIFIC OCCUPANCIES.

Section 5101. SCOPE. The new scope is very general in nature. It no longer refers to specific occupancies as before. It reads as follows: "The provisions of this article shall apply to occupancies or parts of occupancies which are or may be hazardous because of atmospheric concentrations of hazardous gases or vapors, or because of deposits or accumulations of materials which may be readily ignitable. It is the intent to assist Code enforcing authorities in the classification of areas with respect to hazardous conditions which may or may not require construction and equipment conforming to Article 500, and to set forth such additional special requirements as are applicable to the specific occupancy.

PERSONAL COMMENT: It is significant that the scope of this new Article is no longer confined to the hazards presented by gasoline or other highly volatile motor fuel. It now covers deposits or accumulations of readily ignitable materials which are common to paint spraying or other finishing operations. It now applies to the various occupancies covered which may be hazardous due to atmospheric concentrations of any hazardous gas or vapor. The fine print note, following 5102, referring to NFPA standards likewise is important. While the application of such standards is not mandatory, they do contain useful information to the Code enforcing authority in his consideration of the degree of hazard involved.

Without going into all the details and a word for word reproduction of the new text, I shall endeavor to cover the important changes by comment.

COMMERCIAL GARAGES, REPAIR AND STORAGE.

Section 5105 a. This covers the definition of a commercial garage and while it is similar in some respects to the definition of a garage in Article 100, the scope appears to be narrower. It makes a distinction between commercial and residential garages, when used for storage purposes, by a provision which specifies accommodations for more than three vehicles for a commercial garage. This provision however should not be confused with a one car garage used for service or repair as defined.

Section 5105 b. HAZARDOUS AREAS. CLASSIFICATION UNDER ARTICLE 500.

1. For each floor at or above grade, the entire area up to a level 18 inches above the floor shall be considered to be a Class 1, Division 2 location.
2. For each floor below grade, the entire area up to a level 18 inches above the bottom of outside doors or other openings which are at or above grade level shall be considered to be Class 1, Division 2 location. Where adequate positive-pressure ventilation is provided, the authority enforcing the Code may judge that the hazardous location extends up to a level of only 18 inches above each such floor.
3. Any pit or depression below floor level shall be considered to be a Class 1, Division 2 location which shall extend up to said floor level, except that an individual unventilated pit or depression may be judged by the Code enforcing authority to be a Class 1, Division 1 location.
4. Adjacent areas in which hazardous vapors are not likely to be released such as stock rooms, switchboard rooms and other similar locations, having floors elevated at least 18 inches above adjacent garage floor, or separated therefrom by tight curbs or partitions at least 18 inches high, shall not be classed as hazardous.

PERSONAL COMMENT: This new Section, which outlines the hazardous areas in commercial garages, clearly answers many of the controversial questions which have arisen in the past. The old Code, in general, designated any area within 4′ of the floor of a garage as a hazardous location. The new provisions have decreased the area to 18″ above the floor. While this change appears to be radical, it tends to make the restrictions on electrical hazards consistent with hazards inherent with the vehicle itself. Arcs produced by starters, ignition, hot mufflers and occasionally sparks from same are hazards common to the vehicle. They have existed since the birth of the automobile. These spark or heat producing devices have been within the 4′ hazardous area for many years and it was inconsistent to disregard these hazards of the vehicle and to concentrate only on the hazards of electrical wiring and devices. This condition, coupled with field experience over a long period of time, was the principal consideration in support of this change. The new provisions clarify the question of floors below grade and give, in this respect, some recognition to the use of positive-pressure ventilation. The question of pits has been clarified and the provisions for cut-offs from adjacent areas, consisting of curbs or partitions 18″ high also clarify the many questions arising in this respect.

Under Section 5105 d, provisions for sealing appears. It reads as follows: "Approved seals conforming to the requirements of Section 5015 of Article 500 shall be provided, and sub-paragraph b-2 of section 5015 shall apply to horizontal as well as to vertical boundaries of the defined hazardous areas. Raceways embedded in a masonry floor or buried beneath a floor shall be considered to be within the hazardous area above the floor if any connections or extensions lead into or through such area."

Sections 5105 e and f distinguishes the hazards of wiring installed in spaces above hazardous areas from the hazards involved with equipment, which produces arcs and sparks, located above hazardous areas. These Sections read as follows:

"WIRING IN SPACES ABOVE HAZARDOUS AREAS.

1. All fixed wiring shall be in metallic raceways which shall be construed to include Type MI cable. Cellular metal floor raceways may be used only for supplying ceiling outlets or extensions to the area below the floor, but such raceways shall have no connections leading into or through any hazardous area above the floor. No electrical conductor shall be installed in any cell, header or duct which contains a pipe for steam, water, air, gas, drainage, or other service except electrical.
2. For pendants, flexible cord suitable for the type of service and approved for hard usage shall be used.
3. For connection of portable lamps, motors or other appliances, flexible cord suitable for the type of service and approved for extra hard usage shall be used.
4. If a circuit which supplies portables or pendants includes an identified grounded conductor as provided in Article 200, receptacles, attachment plugs, connectors, and similar devices shall be of polarized type, and the identified conductor of the flexible cord shall be connected to the screw shell of any lampholder or to the identified terminal of any appliance supplied.
5. If a pendant is used to supply a portable lamp or appliance, the female portion of a polarized pin-plug connector or equivalent shall be attached to the lower end of the pendant, and the male portion shall be attached to the cord for the portable. The connector shall be designed to break apart readily in any position, and shall be suspended at a level not less than that specified in paragraph b of this section. Attachment plug receptacles in fixed position shall be located above the level specified in paragraph b."

Section 5105 f. EQUIPMENT ABOVE HAZARDOUS AREAS.

1. Equipment which is less than 12 feet above floor level, and which may produce arcs, sparks or particles of hot metal, such as lamps and lampholders for fixed lighting, cutouts, switches, receptacles, charging panels, generators, motors, or other equipment having make and break or sliding contacts, shall be of totally-enclosed type or shall be provided with suitable guards or screens to prevent escape of sparks or hot metal particles.
2. Lampholders for fixed lighting shall have non-conducting outer casings.
3. Portable lamps shall be equipped with handle, lampholder, hook and substantial guard attached to the lampholder or handle. All exterior surfaces which might come in contact with battery terminals, wiring terminals, or other objects shall be of non-conducting material or shall be effectively protected with insulation. Lampholders shall be of unswitched type, and shall not provide means for plug-in of attachment plugs. Outer shell shall be of moulded composition or other material approved for the purpose, and metal-shell, lined lampholders, either

of switched or unswitched type, shall not be used. Unless the lamp and its cord are supported or arranged in such a manner that they cannot be used in the hazardous areas classified in paragraph b of this section, they shall be of a type approved for such hazardous locations.

RESIDENTIAL STORAGE GARAGES.

At the present time a residential garage may accommodate six cars or less. The new provision restricts this type of garage to three cars or less. The hazardous areas of such garages are defined as follows:

5110 b. AT OR ABOVE GRADE. Where the lowest floor is at or above adjacent ground or driveway level, and where there is at least one outside door at or below floor level, the garage area shall not be classed as a hazardous location.

5110 c. BELOW GRADE. Where the lowest floor is below adjacent ground or driveway level, the following shall apply.

1. The entire area of the garage or of any enclosed space which includes the garage shall be classified as a Class 1, Division 2 location up to a level 18 inches above the garage floor. All electrical equipment and wiring within such hazardous location shall conform to applicable provisions of sections 5011 to 5026 inclusive of Article 500.
2. Wiring and equipment above the defined hazardous location shall conform to the requirements of this Code for non-hazardous locations.
3. Adjacent areas in which hazardous vapors or gases are not likely to be released, and having floors elevated at least 18 inches above the garage floor, or separated therefrom by tight curbs or partitions at least 18 inches high, shall not be classed as hazardous.

These new requirements answer questions which have arisen with respect to garages attached to residences and the installation of heating equipment, such as an oil burner in such locations.

AIR CRAFT HANGARS.

These occupancies are now specifically covered by Section 5115 which is divided into twelve parts and many new provisions are made. In view of the extensive coverage and the fact that such an occupancy is special and not of special concern to the majority of our readers, we will refrain from discussing this occupancy.

GASOLINE DISPENSING AND SERVICE STATIONS.

In view of the general concern with the type of occupancy and the many changes involved, we are quoting the entire provisions.

5120 a. DEFINITIONS. This classification shall include locations where gasoline or other volatile flammable liquids are transferred to the fuel tanks (including auxiliary fuel tanks) of self-propelled vehicles. Dispensing islands are areas elevated above surrounding surfaces and on which are mounted dispensing pumps or other dispensing devices. Where an individual pump or dispensing device is not mounted on an elevated island, an area extending 18 inches in all directions from the base of the pump or device shall be considered to be a dispensing island.

Other areas used as lubritoriums, service rooms and repair rooms, and offices, salesroom, compressor rooms and similar locations shall conform to section 5105 with respect to electrical wiring and equipment.

b. HAZARDOUS AREAS.

1. The area of a dispensing island shall be considered to be a Class 1, Division 1 location which shall extend upward to a level 4 feet above adjacent driveway level, and which shall include any space within or under the island which may contain electrical wiring or equipment.
2. In an outside location, any area (includng buildings not suitably cut off) within 20 feet horizontally from any dispensing island or pump, or from any tank fill-pipe or tank vent-pipe, shall be considered to be a Class 1, Division 2 location which shall extend upward to a level 18 inches above driveway or ground level. Electrical wiring and equipment below the surface of such areas shall be considered to be within a Class 1, Division 1 location.

c. WIRING AND EQUIPMENT WITHIN HAZARDOUS AREAS. All electrical equipment and wiring within the hazardous areas defined in paragraph b shall conform to applicable provisions of sections 5011 and 5026 inclusive of Article 500.

d. WIRING AND EQUIPMENT NOT WITHIN HAZARDOUS AREAS. Wiring and equipment not within hazardous areas defined in paragraph b of this section shall conform to paragraph e and f of section 5105.

e. CIRCUIT DISCONNECTS. Each circuit supplying equipment in or on a dispensing pump shall be provided with a switch or other acceptable means to disconnect all conductors of the circuit from the source of supply. ("All conductors" would include a grounded conductor)

f. SEALING.

1. An approved seal shall be provided in each conduit run entering a dispensing pump or other equipment on a dispensing island. There shall be no union, coupling, box or fitting in the conduit between the sealing fitting and the point at which the conduit enters the pump or other equipment.
2. Additional seals shall be provided in conformance with section 5015 of Article 500, and sub-paragraphs a.3. and b.2. of that section shall apply to horizontal as well as to vertical boundaries of the defined hazardous areas.
9. Grounding. Metallic portions of dispensing pumps, metallic raceways, and all non-current-carrying portions of electrical equipment, regardless of voltage, shall be grounded as provided in Article 250.

BULK STORAGE PLANTS.

This type of occupancy is covered by Section 5125 a-b-c-d-e-f-g-h. In view of the extensive coverage, the many new provisions and the special nature of the occupancy, space will not permit coverage in this Article which is principally concerned with Code rules generally applied daily by a vast majority of our contractors and wiremen. The new provisions should be read, so that they may be recalled when the occasion arises.

FINISHING PROCESSES.

This type of occupancy formerly was covered under Section 5003 of Article 500. The new provisions are

extensive and clarify many questions which have arisen in the past. Electrostatic spraying and detearing equipment is now recognized and covered with specific provisions. Here again the application is special and it is impractical to cover the matter in this article. The principal purpose of our brief comments is to call your attention to this subject so that you may recall and refer to same when the occasion arises.

COMBUSTIBLE ANESTHETICS.

Here we have complete coverage of the hazards involved with hospital operating rooms, delivery rooms, anesthesia rooms and adjacent areas, due principally to the use of combustible anesthetics. We now have definite Code recognition and Code provisions for such a hazardous occupancy, and the inspector, architect and contractor are able to proceed with the planning and installation of electrical wiring and devices in such occupancies in line with set requirements. Previous to now, inspection authorities faced the responsibility for deciding the issues involved with very little help from the Code. Now the question of decision rests on the Code and not the Inspector. We believe they will be welcomed. In an article of this nature, it would be impracticable to endeavor to cover these new provisions with due justice to the work involved with the preparation. We therefore refer you to the Code itself for the extensive coverage on this subject.

ARTICLE 700.—EMERGENCY SYSTEMS.

The caption of this Article has been changed from Emergency Lighting to Emergency Systems, in line with the new extended scope. The entire text also has been changed.

Section 7001. SCOPE. The provisions of this article shall apply to the installation, operation, and maintenance of circuits, systems, and equipment intended to supply illumination and power in the event of failure of the normal supply or in the event of accident to elements of a system supplying power and illumination essential for safety to life and property, where such systems or circuits as are required by Municipal, State, Federal or other codes, or by any agency having jurisdiction.

Emergency systems are generally installed in places of assembly where artificial illumination is required, such as buildings subject to occupancy by large numbers of persons, hotels, theaters, sports arenas, hospitals and similar institutions. In addition to lighting they may provide power for such functions as essential refrigeration, operation of mechanical breathing apparatus, ventilation when essential to maintain life, illumination and power for hospital operating rooms, fire pumps, industrial processes where current interruption would produce serious hazards, public address systems, and similar functions. See NFPA Building Exits Code for specification of locations where emergency lighting is considered essential to life safety.

Section 7002. CAPACITY. Emergency systems shall have adequate capacity and rating for the emergency operation of all equipment connected to the system.

Section 7003. OTHER REQUIREMENTS. All requirements of the National Electrical Code shall apply to emergency systems, except as modified by this article. All equipment shall be approved for use on emergency systems.

7004. TESTS AND MAINTENANCE. The authority having jurisdiction shall conduct or witness a test on the complete system upon installation and periodically afterward. Systems shall be tested periodically on a schedule acceptable to the authority having jurisdiction to assure their maintenance in proper operating condition. Where battery systems or unit equipments are involved, including batteries used for starting or ignition in auxiliary engines, the authority having jurisdiction shall require periodic maintenance. A written record shall be kept of such tests and maintenance.

PERSONAL COMMENT: Under these new provisions, it will be necessary for an electrical inspection bureau having jurisdiction to conduct or witness a test at the time of installation and periodically afterwards as per schedule and to keep records of such tests. Such a bureau must also require periodic maintenance of battery systems or unit equipments and see that a written record is kept of such maintenance. These new provisions are considerably stronger than the old ones.

CURRENT SUPPLY.

Section 7011. SYSTEMS. Current supply shall be such that in event of failure of the normal supply to or within the building or group of buildings concerned, emergency lighting, or emergency power, or both emergency lighting and power, will be immediately available. The supply system for emergency purposes may comprise one or more of the types of system covered in Section 7012 to Section 7015. Unit equipments in accordance with Section 7061 shall satisfy the applicable requirements of this article.

Consideration must be given to the type of service to be rendered, whether of short time duration, as for exit lights of a theater, or for supplying emergency power and lighting due to a long period of current failure from trouble either inside or outside the building, as in the case of a hospital.

Section 7012. STORAGE BATTERY. This provision is similar to the old provision with the exception that emergency power, in addition to lighting, is covered. The statement regarding automobile type batteries is more definite. They shall not be used. Lead batteries of other than the sealed glass jar type should not be used. Previously they were not considered suitable for use for an emergency current supply.

Section 7013. GENERATOR SET. This provision is similar to the old provision with the exception that emergency power is covered. A new sentence however has been added which reads as follows:

"Automobile type storage batteries, dry cell batteries or lead batteries of other than the sealed glass jar type should not be used for starting or ignition uses in engine driven generators." The use of the word "should" indicates a recommendation only. The provision is not mandatory. See Section 1103.

Section 7014. SEPARATE SERVICES. Two services, each in accordance with Article 230, widely separated electrically and physically to minimize possibility of simultaneous interruption of supply.

Section 7015—SUB-SERVICE TAPPED AHEAD OF SERVICE DISCONNECTING MEANS. The provisions for obtaining emergency current by this method is the same as covered by the previous Code. The fine print note following this provision, under 7011-d of the old Code has been eliminated. It reads as follows:

"It is recomended that where available, and in such locations as hospital operating rooms, separate and individual services be required for emergency lighting."

Section 7016. DERANGEMENT SIGNALS. The old Code required such signals where possible while the new requires same when practicable. The distinction is vague. According to the definition of practicable, it means the same as possible. This section has been slightly reworded to include signals to indicate when battery charger is properly functioning.

Section 7021. EMERGENCY ILLUMINATION. The wording of this provision is the same as now covered under Section 7003.

Section 7022. CIRCUITS FOR EMERGENCY LIGHTING. The provisions of this section are similar to those covered by the present requirements. The wording has been changed in the interest of clarity but there is no change of substance. A new fine print note has been added which reads as follows:

"Emergency lighting systems should be so designed and installed that the failure of any individual lighting element, such as the burning out of a light bulb, cannot leave any space in total darkness."

It appears to me that this recommendation would cover, as an example, the emergency lights in the toilets of a small theater where it would be necessary to install at least a two lamp lighting fixture.

Section 7023. CIRCUITS FOR EMERGENCY POWER. This provision, which reads as follows, is new:

"Branch circuits which supply equipment classed as emergency shall be supplied with an emergency supply source to which the load will be transferred automatically and immediate upon the failure of the normal supply."

Section 7024. INDEPENDENT WIRING. The wording has been changed principally in the interests of clarity. It reads as follows:

"Emergency circuit wiring shall be kept entirely independent of all other wiring and equipment and shall not enter the same raceway, box or cabinet with other wiring except in the case of transfer switches or exit and emergency lights supplied from two sources or as otherwise permitted in this Article."

Section 7025. CONNECTION TO APPLIANCES. No change in substance.

Section 7026. AUXILIARY SOURCE. This provision is new. "The requirements of section 7002 and 7011 shall also apply to installations where the entire electrical load on a service or sub-service is arranged to be supplied from a second source such as in the instance of a power plant on a college campus or at a hospital with ties to public power systems for emergency purposes. Current supply from a standby power plant shall satisfy the requirements of availability in section 7011."

CONTROL.

Section 7041. SWITCH REQUIRED. Circuits for emergency illumination shall be controlled through switches accessible only to authorized persons. Where two or more switches are installed to control a single circuit these switches shall be of the single throw type and be connected in parallel and at least one of these switches shall be accessible only to authorized persons. Switches in series or three and four way switches shall not be used. Additional switches which act only to put emergency lights into operation but not disconnect them are permissible.

Section 7042. SWITCH LOCATION. All manual switches for controlling emergency circuits shall be in locations convenient to authorized persons responsible for their actuation. In places of assembly such as theatres a switch for controlling emergency lighting systems shall be located in the lobby or at a place conveniently accessible thereto. In no case shall a control switch for emergency lighting in a theatre or motion picture theatre be placed in a motion picture projection booth or on a stage, except that where multiple switches are provided, one such switch may be installed in such location if so arranged that it can energize, but not disconnect, the circuit.

Section 7043. OTHER SWITCHES.

a. Those lights on the exterior of the building which are not required for illumination when there is sufficient daylight may be controlled by an automatic light-actuated device approved for the purpose.

b. Switching arrangements to transfer corridor lighting in patient areas of hospitals from overhead fixtures to fixtures designed to provide night lighting may be permitted, provided the switching system is so designed that switches can only select between two sets of fixtures and cannot extinguish both sets at the same time.

PERSONAL COMMENT: These 3 new requirements for control of an emergency system apply to a large degree to emergency illumination. The first sentence of Section 7042 appears to be the only reference to power circuits. The old provision for control through one switch only has been replaced by the recognition of multiple switching under the conditions stipulated. Many of the old provisions remain.

OVERCURRENT PROTECTION.

Section 7051. ACCESSIBILITY. The branch-circuit overcurrent device shall be accessible to authorized persons only.

COMMENT: This is the same as now required by Section 7042. The present requirement of Section 7041 which permits only the service overcurrent devices to be placed ahead of the branch-circuit overcurrent devices has been deleted. Field experience indicates that it was impracticable to enforce in many instances.

UNIT EQUIPMENTS.

Section 7061. UNIT EQUIPMENTS. Where permitted by the authority having jurisdiction, in lieu of other methods specified elsewhere in this article, individual unit equipments for emergency illumination shall consist of (a) battery, (b) battery charging means when a storage battery is used, (c) one or more lamps, and (d) a relaying device arranged to energize the lamps automatically upon failure of the normal supply to the building. The batteries shall be of suitable rating and capacity to

supply and maintain at not less than 91% of rated lamp voltage the total lamp load associated with the unit for a period of at least ½ hour. Automobile type batteries or lead batteries of other than the sealed glass jar type should not be used.

Unit equipments shall be permanently fixed in place (i.e. not portable) and shall have all wiring to each unit installed in accordance with the requirements of any of the wiring methods in Chapter 3. They shall not be connected by flexible cords. The supply circuit between the unit equipment and the service, feeders, or the branch circuit wiring shall be installed as required by Section 7024. Emergency illumination fixtures which obtain power from a unit equipment and are not part of the unit equipment shall be wired to the unit equipment as required by Section 7024 and by one of the wiring methods of Chapter 3.

PERSONAL COMMENT: This provision is new, and its use is subject to the permission of the authority having jurisdiction. It covers only emergency illumination.

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How To Estimate

ELECTRIC HEATING LOADS

A roundup of design factors in electric heating application

by W. T. Stuart

ELECTRIC space heating application involves traditional heat load estimating methods modified by the special considerations imposed by the characteristics of the energy source, its advantages and its limitations.

In conventional heating design the target is not critical. Close balance in heat distribution and combustion efficiency are characteristics of merit. Liberal overall design to provide full heating comfort at the worst temperature extremes is good practice. Rate of fuel consumption in execess of maximum demand is unimportant. Fuel consumption is moderately important.

In electric heating design the target may be critical. Perfect heat balance can be achieved easily with appropriate zone or individual room control. Of the energy used, 100% is converted to heat within the heated area. Overall design capacity is often a critically exact value necessary to maintain a barely acceptable inside temperature at the lowest outside temperature. Maximum rate of energy use and amount of energy use are of the utmost importance.

Practical electric heating application is usually a compromise between traditional heating objectives and the realities of energy cost in the area.

Where installed heating capacity is always a little more than the maximum heating requirements the total season fuel consumption or energy use is a function of the degree-days. This relationship provides a useful method of approximating the season's heating cost.

Rate of heat loss per deg per Btu per hour x 24 (hours) x degree-days = annual heat requirements in Btu. In electrical terms this will be

Rate of heat loss per deg. in watts x 24 (hours) x degree-days = annual heat requirements in watt-hours.

It may be deduced from the above that, for a particular structure, the rate of heat loss per degree temperature difference is a factor that can be modified to affect the total energy use. Consequently, in electric heating applications where energy cost is important, effective heat insulation and control of air change become prime considerations.

Load Limiting

Utility rate structures generally do not encourage the use of electricity for space heating. Distribution and generating capacity must be maintained to serve a maximum load which pays off in maximum kilowatt-hours during relatively few days in the year. During the rest of the time only a varying fraction of that expensive investment produces actual kilowatt-hour revenue.

More than likely the designer will encounter a "demand charge" in the applicable rate based upon the measured maximum peak load during the year. Therefore it behooves the designer and the user to employ means to avoid unnecessary peaks in energy use where rate structures impose such charges.

Holding installed heating capacity to a minimum is widely advocated. With modern building insulation, tight weatherstripping of doors and windows and double glazing the rate of heat loss per unit of volume is greatly reduced. There is also a correspondingly longer delay in the effect of outside weather changes on inside temperature. As insulation improves, the heat requirements tend to respond more closely to the mean outside temperature over many hours.

On this basis some designers will apply for a well insulated structure a design minimum temperature 10 to 15 degrees higher than that traditionally used in the area. The result is a system of proportionately lower capacity and lower maximum demand.

Some residential systems are deliberately designed for a lower temperature, about 60 deg., in halls, bedrooms, basements, etc. at minimum outside temperature while maintaining full comfort temperatures in the rest of the living quarters. This practice will also result in a reduction in installed capacity and demand.

Minimizing installed capacity to hold down maximum demand is not always effective. Lighting, cooking and power loads coming in at maximum heating demand can more than offset economies in heating system design.

Another approach to load limiting is automatic shedding of a portion of the heating load as a predetermined demand is reached. One such device is the load regulator. A current relay measures the total load other than the electric heating load. At a predetermined load a switching mechanism is actuated to disconnect the 240 volt heating load and reconnect it on 120 volts, approximately balanced around the neutral.

The effect of this switching is to reduce the heating load by 75% when-

ever other heavy electrical loads are in use. The peak use, which establishes the maximum demand, and consequently an important part of the annual operating cost, contains only one quarter of the installed electrical heating capacity. In colder climates the electric heating system may itself provide the largest load. However, the load regulator would prevent the addition of other heavy electrical demand on top of the heating load.

With modifications of circuitry the load regulator can be used to provide other ratios than that described or it can be used to modify only a portion of the heating load as desired.

Where operating cost is of major importance, both minimum capacity installation and load regulation may be used.

Estimating Heat Loss

The estimator will require the following information from the drawings and specifications:

1. Floor areas.
2. Ceiling heights.
3. Number and size and type of glazing of windows and glass area.
4. Number and size of outside doors.
5. Typical wall, floor and roof sections.
6. Volume of ventilating air.

Several factors must be derived from local weather experience and heating practice. They are:

1. Minimum outside design temperature.
2. Desired inside temperature.
3. Direction of maximum exposure (if temperature minimums are accompanied by winds).
4. Area degree-days.

In addition, the estimator will need a set of characteristic heat transmission factors for various wall and floor constructions. An excellent source is the Heating Ventilating Air Conditioning Guide published annually by the American Society of Heating and Ventilating Engineers. Manufacturers of electric space heating equipment often publish application pamphlets or manuals containing the necessary data.

Buildings designed to include electric heat are usually well insulated and tightly constructed. Good insulation can reduce the loss in a typical wall section by two-thirds. Double glazing will reduce glass area losses by more than half. The cost of electric energy for heating will usually justify special care in insulation design and workmanship to minimize heat loss.

For partitioned areas the heat loss estimate is developed for each enclosed area separately. It is usually convenient to work from the top story down. If large open floors are to be operated by zones, heating requirements for each zone should be separately estimated as though they were actually partitioned.

Top floor rooms will have heat losses through the ceiling and outside walls. An enclosed but unheated attic will modify the ceiling loss. A ventilated attic space must usually be considered as at outdoor temperature.

Middle floor rooms will have heat losses through outside walls. Bottom floors will have losses in outside walls and floors. Floor losses will be modified by a basement. Basements will have heat losses through outside walls above grade, outside walls below grade and through the floor to the ground below.

In some types of modern one story structures, notably ranch houses and suburban shopping centers, each room or area will have ceiling, outside wall and floor losses.

All areas will have losses due to air changes by infiltration or essential ventilation.

The usual order of listing is glass area, door area, exposed wall area, partition area (if there is a design temperature difference) and air change. Closets and such structural features as columns are included as part of the room area (however, electric heating units must not be installed in closets).

Glass areas are totaled. The appropriate rate of heat loss factor in watts is applied and the result multiplied by the design temperature difference. The gross exposed wall area is reduced by the glass area to find the net wall area. Heat loss and design temperature factors are similarly applied. Similar calculations give the loss through ceilings, floors or interior partitions. Air change is based on cubic content allowing ½ to 2 changes per hour. The amount is multiplied by the appropriate factor and the design temperature difference.

If carried out in watts, the sum of the heat losses through the various exposures and air change will give the installed electric heating capacity necessary to balance the loss of the area at the design temperature difference.

The same procedure is carried out room by room until the detailed estimate is complete.

Some special considerations are encountered at first floor and basement levels. Floor losses into unexcavated but ventilated areas are based upon outdoor temperature in the area below the floor. Floor losses into a tight unheated basement may be approximated by using ½ the design temperature difference. Floor losses into a basement heated to a lower temperature than the rooms above may be estimated on the basis of the actual temperature difference.

Floor losses in a poured slab occur largely through the edge of the slab. They may be approximated by considering the area of the exposed surface of the slab (not just the edge) as a concrete wall of the same thickness as the slab and applying the appropriate heat transmission factor.

If the basement is to be heated, suitable radiation must be installed. The heat loss of portions of the wall exposed above ground is calculated in the conventional way. The heat loss of the walls and floor area in contact with the ground may be approximated by a heat transmission factor of 3 watts per 100 sq. ft. per degree at ½ of the design temperature difference.

A well constructed, tight, occassionally-used basement will have little air change. Unless provision is made for ventilation, no air change heat capacity is required.

Heat loss by transmission through walls may be expressed by the formula

$H = U \times \text{Area} \times t_d$

where H = maximum heat loss in Btu per hour at design temperature difference

U = coefficient of heat transmission of the wall section in Btu per hour per square foot per degree F temperature difference

area = square feet

t_d = indoor design temperature minus minimum outdoor temperature

The values may be expressed in electrical units.

$E_t = .293H = .293U \times \text{area} \times t_d$

where E_t = maximum heat loss in watts at design temperature difference,

.293 = watts per Btu per hour

Further, .293U may be replaced by an electrical equivalent $W_t = .293U$ so that

$E_t = W_t \times \text{area} \times t_d$

Sensible heat loss in air change may be expressed $H = .018\ Qt_d$ where Qt_d = volume of outside air in cubic feet per hour

Expressed in electrical units this becomes $E_t = .053\ Qt_d$

For convenience $W_t \times t_d$ and $.0053t_d$ can be set up in handy tables or shown graphically.

People, artificial lighting, appliances, motors and machinery all contribute heat energy to the space they occupy. The sensible heat output of an average seated adult is about 70 watts. This value is seldom considered in heat capacity design (although it can be very important in heat control) because in places of assembly where the number of people might provide a substantial heat source it is usually necessary to heat the empty area comfortably before the arrival of the audience.

Artificial lighting in constant use, as in stores and offices during working hours, is becoming an increasingly important factor in calculating heating as well as cooling loads. The rated wattage of the lighting equipment may be considered as resistance heating in the area and may be used in totalling installed heating capacity.

In industrial applications electric motor and machinery load under continuous operation will have a heating effect of an equivalent load in electric resistance heaters. Heating capacity design may include the effect of machinery. To cover periods of shutdown, however, the installed heating capacity should be able to maintain a temperature of at least 40 degrees without the auxiliary output of motors and machinery.

Laundries, bakeries, commercial kitchens and many industrial processes may produce a surplus of heat in normal operation, but heat must be available to carry the space and equipment through the off hours. Automatic electric resistance heaters are particularly adaptable to such service and an inside temperature design of 50 deg. may be adequate.

Wiring Capacity

The electric service and wiring system capacity must be designed to carry the maximum heating load in addition to the normal power and lighting loads.

The additional capacity may be calculated from the total connected heating load plus a 25% margin for wiring design. It should be noted that electric heating is a continuous load. Consequently the actual load on switches, overcurrent devices and wiring should not exceed 80% of maximum rated capacity.

Conventional heating branch circuits are 240 volt, 2 wire, No. 12 serving a maximum of 4 kw. Overcurrent protection may be fuses or circuit breakers in conventional panelboards. Feeder capacity should be 125% of connected load. Both branch circuits and feeders should be carefully designed to minimize voltage drop.

Voltage drop is of special importance in electric resistance heating systems. As a rule such systems do not involve substantial margins of excess capacity. The capacity rating of the units are based upon full design voltage. From Ohms Law we find $W = I^2R$. Thus with constant R a reduction in voltage, and consequently current, will appear squared in the watts output. Since maximum voltage loss, or minimum voltage at the terminals, will occur under full load conditions, excessive voltage loss may drop the available capacity of the system substantially below the necessary design

TABLE 1

Rate of heat transmission in watts per square foot for temperature difference indicated

	per deg. temp. dif.	30°	40°	50°	60°	70°	80°
Glass areas							
Single glass	.33	9.9	1.3	17	20	23	26
Double glass	.18	5.4	7.2	9.0	11	13	14
Hollow glass block	.18	5.4	7.2	9.0	11	13	14
Doors							
Thin panel	.25	7.5	10	13	15	18	20
1½ in. solid	.15	4.5	6.0	7.5	9.0	11	12
Walls, masonry							
12 in. brick, plaster	.10	3.0	4.0	5.0	6.0	7.0	8.0
12 in. brick, furred lath and plaster	.072	2.2	2.9	3.6	4.3	5.0	5.8
12 in. brick, furred 1 in. blanket insulation lath and plaster	.038	1.1	1.5	1.9	2.3	2.7	3.0
12 in. hollow cinder block, plaster	.14	4.2	5.6	7.0	8.4	9.8	11
12 in. cinder block, furred lath and plaster	.09	2.7	3.6	4.5	5.4	6.3	7.2
12 in. cinder block, furred, 1 in. blanket insulation lath and plaster	.041	1.2	1.6	2.0	2.5	2.9	3.3
12 in. concrete, plaster	.16	4.8	6.4	8.0	9.6	11	13
12 in. concrete, furred, lath and plaster	.10	3.0	4.0	5.0	6.0	7.0	8.0
12 in. concrete, furred, 1 in. blanket insulation, lath and plaster	.044	1.3	1.8	2.2	2.6	3.1	3.5
Walls, frame							
wood siding, wood sheathing, insulating board lath and plaster	.056	1.7	2.2	2.8	3.4	3.9	4.5
same with 2 in. bat insulation	.025	.75	1.0	1.3	1.5	1.8	2.0
Brick siding, wood sheathing, insulating board lath and plaster	.059	1.8	2.4	3.0	3.5	4.1	4.7
same with 2 in. bat insulation	.025	.75	1.0	1.3	1.5	1.8	2.0
Stucco, wood sheathing, insulating board lath and plaster	.065	2.0	2.6	3.2	3.9	4.6	5.2
same with 2 in. bat insulation	.026	.74	1.0	1.3	1.6	1.8	2.1
Partitions, interior metal							
lath and plaster both sides of 2 x 4 studs	.12	3.6	4.8	6.0	7.2	8.4	9.6
plywood both sides of 2 x 4 studs	.067	2.9	3.9	4.8	5.8	6.8	7.8
same with 1 in. insulation	.043	1.3	1.7	2.2	2.6	3.0	3.4
Clay tile, plaster both sides	.12	3.6	4.8	6.0	7.2	8.4	9.6
Gypsum tile plaster both sides	0.79	2.4	3.2	3.9	4.7	5.5	6.3
Ceilings and Floors							
3 in. reinforced concrete, asphalt tile floor covering	.19	5.7	7.6	9.5	11	13	15
with suspended metal lath and plaster ceiling	.11	3.3	4.4	5.5	6.6	7.7	8.8
with double wood floor	.085	2.6	3.4	4.2	5.1	6.0	6.8
Single wood floor, wood joists, lath and plaster	.085	2.6	3.4	4.2	5.1	6.0	6.8
Single wood floor, wood joists, insulating board lath and plaster	.064	1.9	2.6	3.2	3.8	4.5	5.1
same with double wood floor	.056	1.7	2.2	2.8	3.4	3.9	4.5
same with 3 in. mineral wool insulation	.024	.72	.96	1.2	1.4	1.7	1.9
Concrete basement floor poured on ground.	.03	.90	1.2	1.5	1.8	2.1	2.4

TABLE 2

Infiltration and Ventilation Air Heat Loss (sensible) in watts for 1000 cu. ft. per hour for the temperature difference indicated

	per deg. temp. dif.	30°	40°	50°	60°	70°	80°
1000 cu. ft. per hour	5.3	159	212	265	318	371	424

How to use the heat loss tables

GLASS

By take-off find the square foot area of glass window.

From the specification find the type of windows, single or double glass.

Determine the maximum design temperature difference to be applied from local weather experience.

From table 1 select the watts loss factor for the type of glazing and the design temperature.

Multiply by the area in square feet. The result will be the watts transmission loss through the glass area at the maximum design temperature.

Example

8 windows 3 x 6 feet with storm sash. Design temperature inside 70° outside 10° or 60 deg. temperature difference. 8 x 18 (sq. ft.) = 144 sq. ft. glass area. The factor for double glass at 60 deg. t_d is found in table 1 as 11 watts per square feet. 144 (sq. ft.) x 11 = 1584 watts.

WALLS

Find the square feet of exposed wall.

Deduct the glass area.

Proceed as for glass area above.

Example

Room 20 x 20 x 8 feet, 2 walls exposed, 50 square feet of glass, frame construction, wood siding and sheathing, 2 in. bat insulation, lath and plaster. Design temperature inside 70 deg., outside 10 deg. or 60 deg. temperature difference. 2 walls 20 x 8 feet equals 320 square feet. Deducting 50 square feet of glass leaves 270 square feet of net wall area.

From table 1 the factor for the wall construction described at the design temperature is 1.5 watts per square foot

270 (sq. ft.) x 1.5 = 405 watts

CEILING AND FLOOR

Proceed as for walls above

INFILTRATION AND VENTILATION

From the specification determine the required rate of air change or the cu. ft. per hour capacity of ventilating equipment. One air change per hour is often used in the absence of specific data. Multiply the cu. ft. of required air change by the factor for the design temperature found in table 2. The factor is per 1000 cu. ft. per hour.

Example

Room 20 x 20 x 8 feet, air change rate once per hour. Design temperature difference 60 deg.

20 x 20 x 8 = 3200 cu. ft. From table 2 the factor for 1000 cu. ft. at 60 deg. is 318. 318 x 3.2 = 1018

capacity at the time of peak heating demand.

Design Voltage

The nominal voltage rating of electric heating equipment is 120/240 volts. The actual standard design value at the terminals for the rated output is 118/236 volts.

Nominal single phase supply voltages in a particular locality may be anywhere between 110/220 and 125/250 volts. Most will be 115/230 or 120/240 volts. On 3-phase network systems nominal voltage is usually 120/208 volts. Actual supply voltage will vary above and below the nominal value.

For equipment rated at 120/240 volts the following heating output will be available for the terminal voltages, given per 1000 watts rated capacity:

208 volts.....	780 watts
110/220 volts.....	870 watts
115/230 volts.....	950 watts
118/236 volts.....	1000 watts
120/240 volts	1030 watts
125/250 volts.....	1120 watts

Examples

An electrical heating system requires a design input of 34,000 watts. The heating equipment to be used is rated at 2000 watts at 240 volts. The supply is 115/230 volts. How many units will be required?

A 2000 watt unit will deliver at the supply voltage given 2 X 950 (from the table above) or 1900 watts. 34,300 ÷ 1300 = 17.9 or 18 2-kw units.

Electric resistance heating devices are constant energy heat sources. Almost all other central heating systems employ some kind of constant temperature distribution. This is a vitally important distinction which must be considered in design, choice of elements and layout. Unless the heat energy is allowed to dissipate from the electric heating device its temperature will rise indefinitely. Therefore it is necessary to provide 1) assured clearance of the devices from probable enclosure or blocking by drapes or furnishings and 2) inherent temperature limiting controls in the equipment.

Electric resistance heating equipment usually falls into one of the following general types.

Ceiling Panels

Large area ceiling panels operate at a relatively low temperature with a low level of capacity per unit of area. A typical operating surface temperature is 110 deg at 22 watts per square foot.

Ceiling panels are installed over a major proportion of the total ceiling area. The total watts installed must equal or exceed the maximum rate of heat loss. The inherently low operating temperature and the large unobstructed radiation area permits installation without temperaure limiting controls.

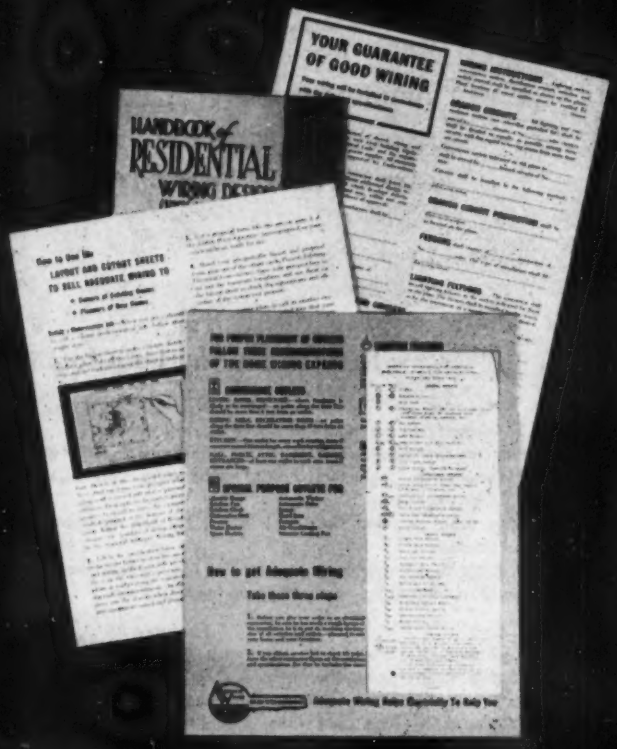
Heating Cable

Heating cables are insulated resistance wires in various types of coverings for imbedding in plaster or finished floors. Like large area panels, heating cables operate at relatively low temperatures with a low level of capacity per unit of length. The cables

(*Continued on page 237*)

IDENTIFICATION AIDS

PROMOTION AIDS



LAYOUT AIDS

A-W Launches

PACKAGED sales aids for the exclusive use of electrical contractors are now available under a new contractor program developed by the National Adequate Wiring Bureau. The program is the first specific and exclusively contractor program the Bureau has offered. It provides to individual electrical contractors the benefit of sales aids and promotional materials developed by N.A.W.B. in its 15 years of selling electrical adequacy with several new items developed specifically for the new program.

The electrical contractor program supplements the work of local adequate Wiring Bureaus and certification programs. It will greatly extend industry adequate wiring efforts, particularly in those areas without organized local adequate wiring promotion. It will provide the individual electrical contractor with the means to coordinate his own sales efforts with powerful national adequate wiring promotion and area-wide programs.

The introductory "Contractor Adequate Wiring Sales Package" costs $10.00 and includes: 1, identification material tying in the contractor as the source of Adequate Wiring information and assistance; 2, information to the contractor on the Adequate Wiring Program; 3, wiring layout helps, proposal forms and wiring standard guides; 4, promotional material directed to the home owner; 5, promotional material directed to the merchant builder and 6, a large twill drop cloth imprinted with the A-W slogan.

Who can participate? All firms regularly engaged in electrical contracting. No organization membership is required.

Is a certification plan included? No. The new program does not provide for individual job certification. Compliance with the standards set forth in the Handbook of Residential Wiring is encouraged but is not required for participation.

Where can the "package" be obtained? The National Adequate Wiring Bureau, 155 East 44th Street, New York 17, N. Y.

Who sponsors the program? The Executive Committee of the National Adequate Wiring Bureau is made up of representatives from five national organizations: The National Electrical Manufacturers Association, the National Association of Electrical Distributors, the National Electrical Contractors Association, the Edison Electric Institute and the International Association of Electric Leagues.

PROSPECT PROMOTION

HOME BUILDERS AGREE: ADEQUATE WIRING
MAKES HOMES MORE SALEABLE..
MORE BUILDERS THAN EVER BEFORE ARE INSTALLING ADEQUATE WIRING

BUILDER PROMOTION

Contractor Program

Introductory Contractor Program Package

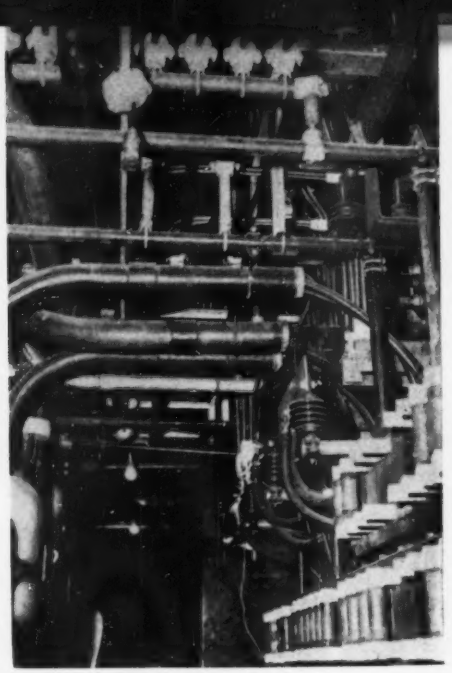
Quantity	Item	Quantity	Item
2	Truck Decals — three colors	1	Price List for Use in Reordering
1	Counter Card — three colors	2	Handbook of Residential Wiring Design
1	Drop Cloth (92" x 56")		Prospect Promotional Material
1	"Wired Any Homes Lately"	3	Newspaper Mats
1	"What Happens—"	1 folder	Advertising Suggestions
	Instruction and Layout Aids	50 folders	Modernizing Your Home
2	Contractor Instruction Folder	50 folders	Do You Live in a Haunted House
1	Electrical Symbol Guide	25 folders	Check Your Wiring
50	Home Wiring Plan Layout Sheets	25 folders	Spend Less Time
50	Layout Cutout Cards	25 folders	Get Rid of This
		25 folders	For Better Living (Check Guide)
			Merchant Builder Promotional Material
		15	"Here's Why Most of Us Builders . . ."

MI Cable for Revamped Switchboard Feeders

provides higher capacity and temperature range plus installation flexibility at Harper Hospital in Detroit

By Fred J. Somes, Jr.

Vice President, Motor City Electric Company, Detroit, Michigan



THROUGH CONGESTED AREA behind main switchboard the 4/0 MI cables (0.699" O.D.) snake down to bus bar lugs with room to spare. No existing conduits had to be shifted.

REVAMPING of transformer banks and service to the Harper Hospital in Detroit involved removal of 30-year old, 500MCM, rubber-covered feeders (two per leg) to the main switchboard. Insulation on these cables, which lay in a floor trough underneath the board, was thoroughly baked out due to overloads and excessive ambient temperatures in the enclosure. Plans and specifications called for replacement of the old feeders with new 500MCM type AVA cables.

The project was figured according to this design and the contract awarded to Motor City Electric Company on a competitive basis. When MCE engineers began detailing installation procedure they encountered these obstacles: (1) a ten-month delivery on AVA cable at that time; (2) congested areas behind the switchboard; (3) relocation of existing conduit circuits and switch equipment to make way for the new feeders; and (4) maintenance of an absolute minimum of down-time during the changeover.

While searching for a compact method of doing the job, the MCE staff investigated the possibility of using the new Safety Mineral Insulated Wire (Type MI, approved and recognized in a new Article 330 of the 1953 National Electrical Code). These conductors are insulated with a highly compressed refractory mineral insulation (magnesium oxide) encased in a liquidtight and gastight metallic tube sheathing (copper). This type of cable was available for immediate delivery.

Based on careful engineering study, Motor City Electric recommended this alternate feeder design: Two No. 4/0, type MI cables per leg from the transformer banks (three 200-kva, single-phase, 4800/220-volt outdoor transformers per bank) to sectionalizing breakers at the top of the main switchboard. The 4/0 MI cable would carry 435 amperes per leg when the 200-kva transformers were fully loaded and operated at about 110°C. Manufacturer's recommendations call for operating temperatures up to 250°C. with voltage drop as the governing factor. Since the actual length of the longest run was about 25 feet, voltage drop would be less than 1%. MCE engineers also felt that there was ample capacity in this system to carry overloads up to 50% in case of a transformer failure.

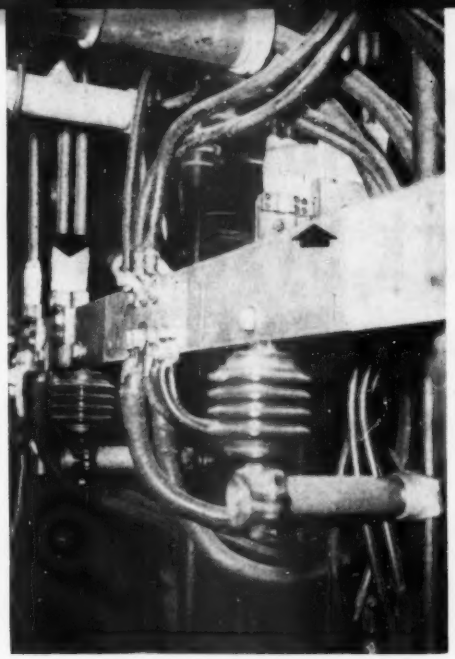
This alternate feeder design was accepted by the project consulting engineers, Snyder & McLean, Detroit; by Harry Caddell, Harper Hospital engineer; and approved by special permission of the chief electrical inspector of the City of Detroit.

Actual installation of the cable was comparatively simple. The 0.699-in. outside diameter of the cable permitted it to be slipped down through the switchboard congestion for bus bar connection. The group of 12 cables (from two transformer banks) were racked in double-tier on cross-brackets behind the board, went down a wall and fanned out to the two floor troughs where connection was made to transformer buses. Non-ferrous straps and brass bolts were used to eliminate any possibility of eddy currents. Ample air space was left between conductors to permit free air circulation and heat dissipation. No existing equipment had to be removed or relocated to make room for the new feeders.

Lug Terminations

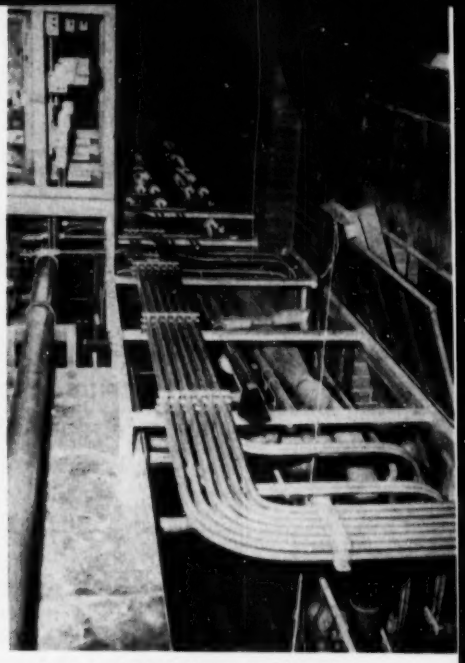
Probably the most critical operation on MI cable is termination of conductors at lugs and connection points. This need not be complicated or difficult. Section 3307 of the 1953 National Electrical Code reads, "At all points where mineral insulated, metal sheathed cable terminates, an approved seal shall be provided immediately after stripping to prevent entrance of moisture into the mineral insulation. . . ." In this case, the two No. 4/0 MI cables per leg terminated in a double solderless (Allen set screw type) lug at the bus bars.

Application of the moisture seal and terminal insulation followed this procedure: After the conductor was stripped a shallow cup was gouged out of the mineral insulation between wire and sheath. This was immediately filled and painted with DC-804 Silicone Resin to produce a moisture seal. Next, the conductor area between sheath and lug was wrapped with lay-

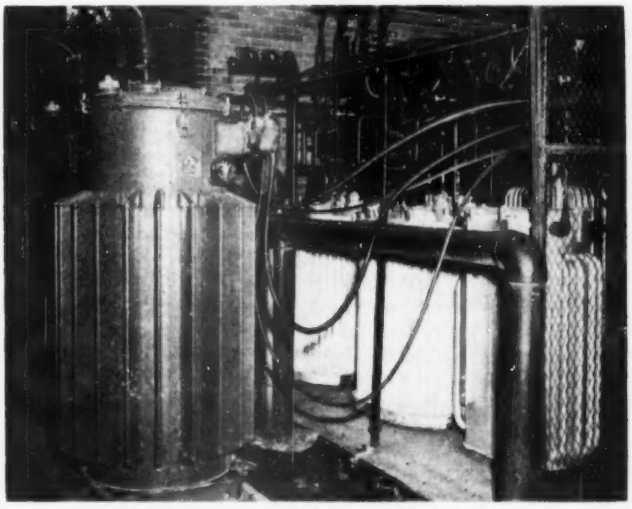


TERMINAL CONNECTIONS at bus consist of double solderless lugs (arrows) with built-up insulation consisting of Silicone Resin moisture seal around bare conductor and mineral insulation.

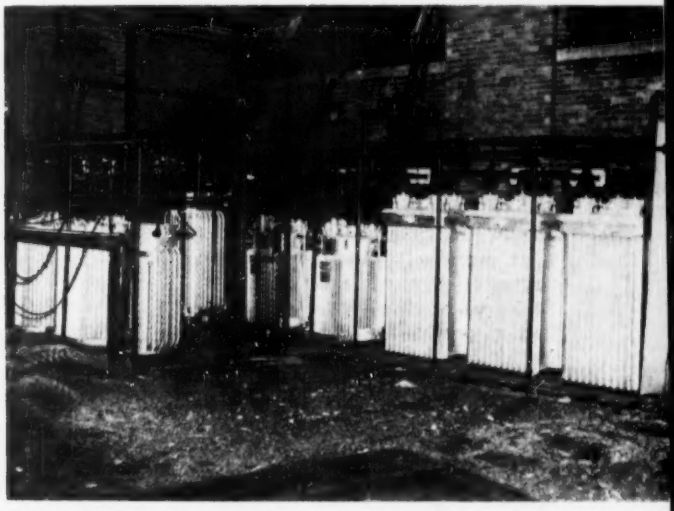
AFTER GOING DOWN WALL behind board, MI feeders fan out at base to enter two existing floor troughs enclosing old 500MCM feeders. Asbestos-cement plates cover opening for lug connections.



RACKED MINERAL-INSULATED FEEDER cables leave switchboard bus and transfer breakers in double tier at back of board. Ample space between cables provides free air circulation.



TEMPORARY TRANSFORMER BANK at left foreground maintained continuous electric service while permanent bank at right was revamped and new feeders installed. Transformers were then shifted to next bank to be rebuilt.



PERMANENT TRANSFORMERS involved in the hospital electrical service rehabilitation project. Secondary buses enter floor troughs at building near top of units. New MI secondary feeders connect to these buses.

ers of R-10 Silastic tape ($\frac{3}{4}$" x 0.010") to a thickness level with the cable sheath. A coat of the Silicone Resin was applied to this level-wrap. A final overlay wrap of Silastic tape from the lug back over the cable sheath was applied and coated with the Resin. A similar technique was used on the terminations at the transformer bus connections.

Concurrent with the feeder installation was the revamping of the transformer banks including installation of new isolating disconnects. To keep down-time to an absolute minimum, a temporary set of three 200-kva transformers were used to maintain continuous electrical service, through temporary feeders to the switchboard. When one group of feeders and transformers were completed, a quick switch was made from the temporary setup to normal service. The "stand-by" transformers were then shifted and used for the next bank to be rebuilt.

The application of MI cable to this specific rewiring problem transformed what might have been an obstacle-ridden project into a simple, time-saving installation. Hospital authorities liked the dispatch with which the job was accomplished; like the additional feeder capacity for emergencies; and are pleased with the assurance that high ambient temperatures will not affect the feeder insulation.

LARGE CAPACITY SERVICES On 208/120 Volt Network Systems

Increasing use of large capacity services with inherent heat problems demands safe installation to prevent fire hazard and better understanding of fundamental design and application principles.

By Eustace C. Soares
Industrial Engineering Services, New York, N. Y.

THE use of large capacity services on 208/120 volt ac network systems is increasing rapidly, and presents an ever increasing challenge to see that installations are safe and will not eventually become fire hazards. Failure to consider the fundamental principles of design for these services results in an inefficient use of copper, excessive heating, and a lack of all the elements of safety. Since the job of an electrical inspector is not that of a trouble shooter, the time to nip sources of later trouble in the bud is through the application of fundamental principles in the approval of layout drawings.

Set forth briefly here are the important fundamentals which affect these problems, factors covering the heating of large services, and the practical application of these to the job itself to provide a well designed service incorporating all the elements of safety.

There are five major points to be considered, as follows: 1) bus configuration and conductor assembly; 2) magnetic induction heat losses; 3) ventilation of equipment as well as room; 4) arrangement of neutral; and 5) grounding.

Fundamentals

1. *Bus configuration and conductor assembly.* First, consider cable and its ability to carry current for the same temperature rise under different conditions.

For direct current where the current is distributed equally throughout the cross section the capacity of a conductor may be increased proportionately within fairly large limits merely by adding cables or bus bars and allowing a reasonable air space for cooling.

The Code restricts the carrying capacity of cables based on the manner in which they are installed. Take any one type of cable, as Type R, and examine its carrying capacity for various conditions (Table I). For the best condition (a single conductor in free air) to the worst cited in the Code (7 to 9 conductors in a raceway), there is a reduction in current carrying capacity to only 43½% of the available, without considering the other potentiality of a room temperature more than 30° C (86° F), which would reduce the carrying capacity still further.

Then consider what happens when 30 conductors are put in a raceway helter skelter. It is obvious that this should not be done yet there are many such installations in service.

When alternating current is considered, the problem of increasing capacity may become complicated. Adding copper bars or cables in parallel does not increase the current carrying capacity proportionately and in fact this practice can easily reach the point where an additional bar or cable may cause virtually no increase in capacity. This is due to the well known "skin effect".

Using 3 in. by ¼ in. rectangular copper bars in parallel, tests have shown that current capacity is not increased proportionately to the number of bars in parallel. The comparative figures are shown in Table II. For the same temperature rise with a single bar, a current carrying capacity of 600 amperes per bar is obtained, which unit capacity constantly decreases as bars are added till with 12 bars the capacity per bar is only 242 amperes, less than 50% of the original. Note also that in going from 10 to 12 bars the last two bars resulted in a capacity increase of only 75 amperes per bar, or 12½% of the capacity of the same bar when used alone. This means that 8 times as much copper as was necessary had to be added. It is plain then that adding bars in parallel is not the economic way to get increased capacity, for such increase may be ridiculously smaller than it appears it should be.

Then again when dealing with large capacities a further distortion of current density results due to the interaction of the magnetic fields between phases. This is known as proximity effect and depends on the current as well as the spacing and arrangement of the conductors.

Note in Table II that in going from 10 to 12 bars the last two bars resulted in an increase of only 150 amperes, or 75 amperes per bar, just 12½% of the capacity of one bar alone. Note also that one 3 in. by ¼ in. bar can operate at a current density of 1,600 amperes per square inch and that the density constantly reduces till when 12 bars are used in parallel the average current density drops to 644 amperes, only 40% of a single bar.

2. *Magnetic and Induction Heat Losses.* Next, consider the magnetic field surrounding a conductor. It varies as the square of the current. The magnetic effect of a current of 4,000 amperes is thus 64 times as great as that of a current of 500 amperes although the current is only eight times larger.

Any conductor placed within an alternating magnetic field will have induced in it an electromotive force or voltage which will cause an induced current to flow within the conductor; while if the conductor is magnetic a magnetomotive force also will develop. Both vary with the strength of the magnetic field or as the square of the current and both represent heat losses which may become appreciable.

If a magnetic conducting material such as steel is placed within an alternating magnetic field two losses result:

TABLE I.

Comparison of Allowable Current Carrying Capacity of 500 MCM Type R Insulated Conductor in Amperes

	Amperes	Percent
1. Single conductor in free air	515	100
2. Three Conductors in a raceway	320	62
3. Four to six conductors in a raceway	256	50
4. Seven to Nine conductors in a raceway	224	43½
5. Thirty conductors in a raceway	?	?

TABLE II.

Comparison of Current Carrying Capacity of Parallel Bus Bars for the Same Temperature Rise

(Using 3" x ⅛" Rectangular Copper Bars)

Number of Bars	Square Inches	Current Carrying Capacity (Amperes)	Average Capacity per Bar (Amperes)	Average Current Density Amperes per Square Inch
1	⅜	600	600	1,600
3	1⅛	1,500	500	1,333
6	2¼	2,350	392	1,044
10	3¾	2,750	275	733
12	4½	2,900	242	644

a magnetic or hysteresis loss, and an induced current loss.

If a non-magnetic conducting material such as aluminum alloy is placed within an alternating magnetic field one loss results; an induced current loss. The losses in either material will depend on the distance from the center of the conductor and will vary approximately as the square of the distance.

3. *Ventilation of Equipment as well as Room.* In ventilation it is necessary to deal with and understand the properties of heat flow. Heat flows from a hotter body to a cooler body, never the reverse. The ratio of heat flow is a function of the temperature difference. The terms hot and cold are relative only. For instance, heat flows from a body having a temperature of 400° F to a body having a temperature of 300° F although both bodies are not only hot, but very hot. The rate of heat transfer depends on the medium. Water is a good heat transfer medium. On the other hand, air is a poor heat conductor; in fact, it is used as a heat insulator very effectively as evidenced by storm windows, which depend for their insulating value on a relatively thin layer of air trapped between two glass surfaces.

Only a few watts are required to raise the temperature of a sealed metal enclosure or room materially, if air that cannot circulate outside the enclosure or room is depended on to conduct the heat away. Temperature rise of conductors within a sealed or non-ventilated enclosure can be considered roughly as being double what it would be if means were provided for a natural free air circulation.

4. *Arrangement of Neutral.* It is well established that the neutral must run in the conduit with the phase wires, or undue heating will develop. By the same token, although not as well recognized, when conductors are run in the open even a small piece of structural steel interposed between the neutral and the phase wires may cause undue heating.

5. *Grounding.* With a given voltage the maximum current that will flow in a circuit is dependent on the resistance or impedance of the circuit. That fact is of great practical importance when fault currents are considered, and determines the method of grounding which must be employed. As stated in Chapter 10 of the National Electrical Code, "It should be noted that even the best grades of rubber insulation will deteriorate in time, so eventually will need to be replaced". Since most faults occur to ground we must never lose sight of that fact.

Application of Fundamentals

How the application of these fundamentals as outlined above affect a large capacity service is discussed below.

1. *Bus Configuration and Conductor Assembly.* The service and load feeders may consist of cable or bus. Take a case where ten 500 MCM cables are used per phase. There is nothing wrong in throwing these 30 phase cables plus the neutral cables in a steel duct or trough, if the very high price of reduced capacity is acceptable. This method is not uncommon, and because the high reduction of capacity to be expected is usually not considered, the cables are fully loaded when carrying perhaps even less than 50% of the allowable carrying capacity of three conductors in a raceway. This results in another source of undue heating and may cause hot spots that will create a fire eventually.

If however, unless the run were very short, the cables were racked to give free access to air circulation and set up in groups of A, B, C & N, an installation giving less voltage drop, better regulation, lower reactance and less temperature rise for the same current will result. Also, when multiple cables are used they should be protected with limiter lugs on each end.

Multiple rectangular bus bars on ¼ inch spacing is a very common practice much to be deplored. Reference is made here to 60 cycle ac circuits, and not to dc circuits where such a practice would be perfectly correct within wide limits. By paying some attention to bus configuration, a reduction in heating will result.

Table III shows that, for the same temperature rise and with proper spacing only, the same number and size of copper bars will carry

15% more current for 2 bars,
28% more current for 3 bars and
18% more current for 4 bars.

There is the greatest increase in capacity for 3 bars as compared with 2 or 4. Why? Going back to the fundamentals, it is seen that the skin effect of alternating current causes the current to crowd to the outside edge of the conductor, so that the copper in the center of the conductor is working inefficiently. For 2 or 4 bars there is no copper exactly in the center of the conductor while for 3 bars one bar is exactly in the center of the conductor. Spacing the three bars in special configuration removes one of the conductors from the center of the conductor and up goes the carrying capacity, in this case 28%.

Assume a commonly used arrangement of 4—¼ by 4 bars on ¼ inch spacing, referred to as a 4,000 ampere bus. Table III shows such a bus is capable of carrying only 2,800 amperes for a 30° C rise over a 40° C ambient (4 sq. in. of copper). Using only 3—¼ by 4 bars, and arranging them properly, results in a capacity of 3,120 amperes

TABLE III.

Current Carrying Capacity — Rectangular Copper Bars

(30 deg C Rise Based on a 40 deg C Ambient)

ALL ¼" SPACING

Capacity ¼ x 4 Bars	Square Inches	Current Density	Capacity ¼ x 6 Bars	Square Inches	Current Density
1,220	1	1,220	1,660	1½	1,107
1,925	2	962	2,620	3	873
2,440	3	813	3,320	4½	738
2,800	4	700	3,815	6	636
3,720 or equivalent to 3,585 amperes for 4 square inches. (4" x 5/16" ventilated bus)	4.15	896			

Capacity ¼ x 4 Bars	Square Inches	Current Density Amps per Sq. Inch	Capacity ¼ x 6 Bars	Current Density Amps per Sq. Inch	Percent increase in Capacity with Improved Configuration
2⅜" —	—	—	—	—	—
2,220	2	1,110	3,020	1,007	15
3,120	3	1,040	4,250	944	28
3,315	4	830	4,515	752	18

Note: The arrangements shown at left are the most efficient for 3 or 4 bars but do not lend themselves readily for practical use especially if the bus is to be tapped.

The above values do not take into account the loss in carrying capacity owing to proximity effect.

for only 3 sq. in. of copper. With 25% less copper an increase of 11½% in carrying capacity is obtained. Why then are copper bars put on ¼ inch spacing? It can be assumed that it is only the outgrowth of a habit pattern of the dc days that still persists in too many places. It is estimated that millions of pounds of copper have been wasted over the years, surely an economic waste.

If a single flat bar in a 3 phase circuit is used with the phases closely spaced, the most efficient arrangement results, giving high current carrying capacity and very low reactance. Note the current carrying capacity of a single bar in Table III. By using multiples of this arrangement, an interleaved bus is obtained in which the phase relation of the adjacent bars then become A, B, C—A, B, C, etc., depending on the number of circuits used. This is a simple construction, and although it has relatively weak mechanical strength, and the end connections may be complicated, it has low reactance and low voltage drop and with proper supports is much used.

Aside from interleaved bus, ventilated square bus offers the only worthwhile way of designing any bus of more than 4 bars. The use of more than 4 bars in an ac bus is inadvisable from any angle, yet the practice persists.

2. *Magnetic and Induction Heat Losses.* These factors must be reckoned with in enclosure design. If not, undesirable and unnecessary heating will result. Since these losses vary as the square of the current they become increasingly more important as capacity increases.

Enclosures cannot be designed on the basis of voltage clearance only. If not given proper consideration in design work, not only does excess heating occur, but also annoying magnetic noise. In the great majority of installations where noise is a factor it is nearly always due to neglect of magnetic and induction effects.

Consideration must also be given to proximity of building steel and to the distance from the center of a conductor to its enclosure side, or any other magnetic material in the close vicinity.

3. *Ventilation of Equipment as well as Room.* It is impossible to transmit current without using power. This power is expended as heat and is the I^2R loss. For a given conductor this loss then varies as the square of the current. Twice the current means four times the loss in watts.

Two things are obvious. Whenever electricity is transmitted heat loss occurs, and that heat must be removed if temperature rise is to be kept within bounds. The larger the capacity the greater the loss and the greater the need for removing the heat generated. While it is possible to neglect ventilation in a small capacity circuit without undue temperature rise, ventilation becomes more and more essential as the circuit capacity increases.

Enclosed equipment then should be ventilated by providing proper means for air flow. Ample size openings at top and bottom of an enclosure provide better air circulation than if the entire front of the enclosure were removed. From tests it has been determined that if equipment carrying 2,000 amperes or more is enclosed and not ventilated, the temperature rise will be approximately double what it would be if it were properly ventilated. For instance, doubling the size of such an enclosure has no appreciable effect.

The problem of ventilation goes further than the enclosed equipment itself, and must extend also to the room in which the equipment is installed. Inlet openings of the proper size at the floor level and exit openings at the ceiling level must be provided. Moreover such openings must be placed where they will have real value. To have openings which by their very nature and location will be blocked up in time will not be a solution.

Under certain conditions it is essential that equipment must be totally enclosed, but in such cases the equipment should be derated to allow for inability to properly remove the normal heat losses and thus keep the temperature rise within safe bounds.

4. *Arrangement of Neutral.* Because it permits a simple layout, switchboards for 3 phase 4 wire systems have been built in which the service supply cables enter the top of the switchboard, the phase wires go through the service equipment to a bus usually on the bottom of the switchboard, and the neutral runs across the top. In nearly all cases some of the steel structure of the switchboard becomes interposed between the neutral and the phase wires. As the feeders leave the switchboard a tap from the neutral completes each 4 wire feeder circuit. For such arrangements where total currents did not exceed 1,000 amperes with a correspondingly small neutral current, the excess heating was small and presented no problem. Nevertheless, there was some excess heating.

However, as the capacity of circuits increased the heating caused by that arrangement became excessive and very noticeable. An unbalance of 200 amperes in a 3,000 ampere circuit is not unusual. That unbalance is much more than enough to cause trouble if any of the steel structure is between the phase wires and the neutral.

5. *Grounding.* Both the Service Ground and the Equipment Ground introduce an element of safety to personnel, equipment and property. Both must be installed in accordance with the accepted rules. Particular attention must be paid to insure operation of the overcurrent devices on fault currents.

Recommendations

The proper time to insure the best installation is when drawings are submitted to the Inspection Department, and not after the job is installed. Specific recommendations for the five points discussed above are given below.

1. *Bus configuration and conductor assembly.* Approved carrying capacity for cables are given in the Code, which can be used as a guide, keeping in mind the various conditions which influence the carrying capacity. These conditions include type of cable, whether installed in free air, three cables or more in a single raceway, room temperature (if over 30° C), and use of multiple cables in a raceway or trough (Table I).

For bus temperature rise must be considered a guide. The old rule of 1,000 amperes per square inch, or for that matter any other rating per sq. in., is meaningless. For one square inch of copper bar the carrying capacity of 1,000 amperes is conservative, but as square inches go up density goes down for every square inch added. Note the data in Table II.

AC busses, other than interleaved, should consist of not more than 4 bars, with the configuration giving the least temperature rise. Where higher capacities are necessary, square ventilated bus should be used. This does not mean that nothing else can be used, but the arrangements cited will cover most cases and are practical and convenient.

2. *Magnetic and Induction Heat Losses.* Par. 3018 of the Code states: " . . . where a current of more than 50 amperes enters a metal enclosure the conductors . . . shall be so arranged as to avoid overheating of the metal by induction". Table IV shows distances from steel to centerline of conductor which are based on a 10° C rise of the steel enclosure when carrying currents as listed. These data may be used as an approximate guide. An interleaved bus duct may be considered as carrying only that current carried by one of its component circuits, not the total rating of the bus. If the busway makes a right angle turn all distances should be increased to the next higher rating.

If an enclosure and its structural members are made of aluminum alloy of the same cross section as the required steel all of the distances shown in Table IV may be reduced materially, but in any event should be somewhat more than necessary for voltage clearance only, and preferably should be decreased little where actual load is 3,000 amperes or more. It is recommended that where actual currents exceed 3,000 amperes that enclosures be made of aluminum alloy. Tests have shown that with a load of 3,500 amperes there is a saving of 1,000 watts loss if an aluminum alloy enclosure is used instead of a steel enclosure, both having the same dimensions as referred to.

TABLE IV.
Distance from Steel Enclosure to Centerline of Conductor

Amperes	Inches
1,000	6
2,000	10
3,000	12
4,000	14

3. *Ventilation of Equipment as well as Room.* Enclosed equipment as well as the room in which it is installed should be properly ventilated.

Enclosures should have an opening at extreme top and bottom the full width of the enclosure and not less than 4 inches high, but preferably 6 inches, protected with the proper screening. The rest of the enclosure should be covered to get the full chimney effect of air circulation.

The room in which equipment is housed should have an effective inlet opening near the floor having an area about 5% of the square feet of area of the room and arranged to bring in outside fresh air. A similar sized exit opening near the ceiling and at the opposite end of the room should be arranged to deliver the air to the outside or to some room where an abnormal high temperature does not prevail.

4. *Arrangement of Neutral.* The neutral should follow the phase wires through the distribution center. The neutral should not be carried across the top of the switchboard unless no steel whatever, not a single structural member, is interposed between the phase wires and the neutral. There should be no exception to this.

5. *Grounding.* Particular attention should be paid to equipment ground impedance. All switchboards should have a ground strap extending the full length of the switchboard and bonded to each upright section. Also the service ground should be 25% of the capacity of the service. Bonding and the use of copper jumpers should be used to maintain a permanent low equipment ground impedance. On the circuits with 4,000 ampere overcurrent protection the equipment ground impedance must be in the order of 1/100th of an ohm.

Special effort taken at the design stage to insure compliance with the above fundamentals will result in less work for the trouble-shooter and a more efficient and economical use of the equipment.

IAEI SILVER JUBILEE CONVENTION PROGRAM

Monday, Sept. 21

Session Chairmen—International Officers
Charter Presentation to Canadian Chapter
"The Utility Viewpoint of Uniform Inspection"—M. E. Skinner, vice president and director of sales, Union Electric Company of Missouri.
"IAEI and NFPA—A Team for Safety"—Percy Bugbee, general manager, National Fire Protection Association.
"Some Technical Aspects of National Standards"—R. S. Moulton, technical secretary, NFPA.
"Six Divisions of the Service"—R. A. Millermaster, manager of development, Cutler-Hammer, Inc.
Forum—Code Discussion and Inspectors' Problems

Tuesday, Sept. 22

Forum—Informal Code Discussion—early morning
Session Chairmen—Eastern Section Officers
"The Electrical Manuacturer's Contribution to Safety"—W. J. Donald, managing director, National Electrical Manufacturers Association.
"Contractor and Inspector Relations"—E. R. Cornish, director of research, National Electrical Contractors Association.
"The Evolution of Safety in Manufacturing X-Ray Equipment"—J. E. Berg, Coolidge Laboratory, X-Ray Dept., General Electric Company.
Forum—Code Discussion and Inspector Problems

Wednesday, Sept. 23

Forum—Informal Code Discussion—early morning
Session Chairmen—Northwestern Section Officers
"The Insurance Interest in Electrical Safety"—L. A. Vincent, Stock Fire Insurance Group, National Board of Fire Underwriters; and Dale F. Auck, Mutual Insurance Group.
Session Chairmen (afternoon)—Southwestern Section Officers
"Organized Labor's Interest in Sound Electrical Inspection"—J. Scott Milne, international secretary, International Brotherhood of Electrical Workers.
Symposium—"Coordinated Protection of Electric Motors"—Moderator: L. D. Price, manager, Engineering and Safety Regulations Dept., NEMA.
"Why Electric Motors Need Protection"—R. H. Smith, Motor and Generator Section, NEMA
"Inherent Overheating Motor Protection"—V. G. Vaughan, Automatic Temperature and Industrial Control Sections, NEMA.
"Motor Controllers"—J. J. Mellon, Industrial Control Section, NEMA.
"Motor Branch Circuit-Breakers"—J. C. Ingram, Molded Case Breaker Section, NEMA.
Question and Answer Period on Switches—H. I. Stanback, Switch and Enclosed Breaker Section, NEMA.

Thursday, Sept. 24

Underwriters' Laboratories Day—inspection trips through the Laboratories.
Evening—Silver Jubilee Banquet and Dance

Friday, Sept. 25

Forum—Informal Code Discussion—early morning
Forum Discussion—Chairmen: Canadian Section Officers
Topic: Canadian Electrical Code.
"Role of Electrical Controls in Modern Gas Appliances"—Eskil I. Bjork, president, Peoples Gas, Light and Coke Company of Chicago.

IAEI To Meet In Chicago

Silver Jubilee Convention will bring all sections of the International Association of Electrical Inspectors together at Edgewater Beach Hotel Sept. 21-26. Electrical safety will be theme of sessions, forums and product exhibits.

SOME twenty-five years ago the International Association of Electrical Inspectors was formed. Objects of the organization then—and now—are to collect and disseminate information relative to the safe use of electricity and to promote closer cooperation between inspectors, inspection departments, the electrical industry and the public and to provide national and international representation of electrical inspectors in all electrical industry matters.

In the interim the electrical industry has enjoyed tremendous growth and progress. Electrical equipment has become more numerous and systems have become more complicated. The need for electrical safety has grown with the industry. The National Electrical Code—a compilation of minimum safety standards—has kept pace with interim amendments and revisions being made as needed. This month a new 1953 National Electrical Code will be published.

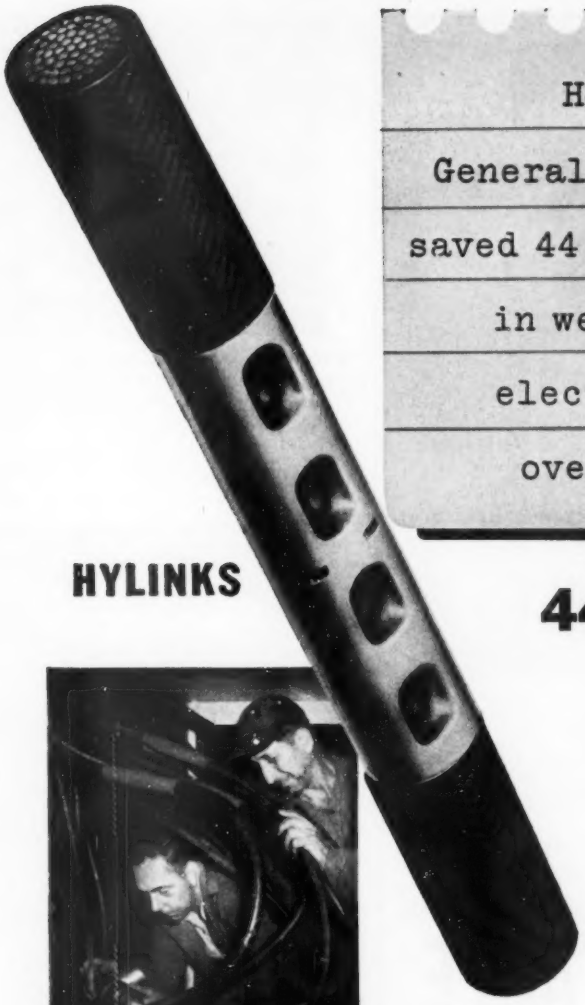
The stature and importance of the electrical inspector has grown tremendously over the past quarter century. Today he is a vital link between the public and the entire electrical industry. He is the authority upon which the public relies for safe wiring installations. His decisions are based on the National Electrical Code or local electrical code if such exists.

In the past inspectors have convened annually on a regional—or sectional—basis to keep abreast of the times; to relate and discuss field problems; to suggest changes in Code regulations. This year, to celebrate IAEI's Silver Jubilee, inspectors from all over the country and Canada will meet in Chicago at an All-Section conference. It will be the first national forum for the promotion of electrical safety. Speakers from all branches of the industry will discuss cooperative means of achieving that common objective.

Inspector meetings have always been working conferences. This year will be no exception. More than 60% of the session time will be devoted to discussion of the new 1953 Code and inspector problems. Members of the various code-making panels—the men who wrote the new Code—will be present to answer all questions. More than 50 manufacturers of electrical equipment will have product exhibits.

The Western Section, convention hosts, and the Illinois Chapter—in charge of arrangements—plan this to be the largest and most successful convention ever held by the IAEI.

How
General Aniline
saved 44 man-hours
in weekend
electrical
overhaul



HYLINKS

44 man-hours saved!

Annual factory shut-down for electrical overhaul and maintenance is a growing trend because it permits major work to be done more quickly, safely, cheaply, with minimum interruption of production.

During the last such overhaul at the General Aniline Works in Graselli, N. J.—Labor Day weekend—*one* of the *big* discoveries was the time saved by using Burndy Hydent connectors on their large power feeders!

"More than 44 man-hours were saved on installations. The smooth surface of the connector permitted faster taping of the connection, since there were no protruding nuts or bolts to be covered. These connectors permitted the use of smaller junction boxes." (Factory, pg. 104, December '51)

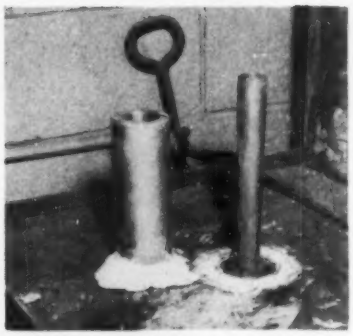
HYPRESS

Whether you're doing annual overhauls or year-round maintenance, Burndy Connectors and installation tools—in every size, type, and service—help electrical engineers and crews do an *important* job *better!*

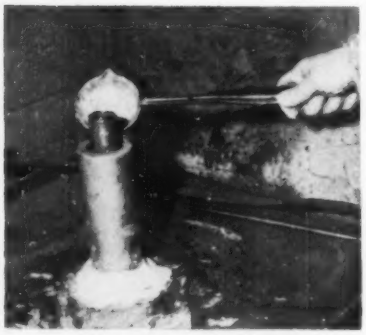
BURNDY

52-18 BURNDY ENGINEERING COMPANY • NORWALK, CONNECT. BURNDY LTD., TORONTO, CANADA

BABBITTING TABLE features exhaust hood over burner and ladle and pouring area at left with pin-centered mandrels. Note set of tapered mandrels on tilted rack under table.



TAPERED MANDREL seats on center pin projecting above surface of metal table. Bearing (at left) is then placed over mandrel and centered by alignment with guide circles scribed on table.



METAL IS POURED between mandrel and bearing. Note clay dam at base. After tapered mandrel is removed, Babbitt lining is machined to specified inside diameter and oil groove requirements.

Tapered Mandrels on

BABBITTING TABLE

. . cut bearing relining time at the Clarence W. Silver Co., shop in Salt Lake City.

IT'S easier to machine a motor bearing with a cylindrical lining of Babbit metal than one with a solid core poured during the relining process. Based on this logical premise, shop superintendent J. D. Morgan uses a series of tapered mandrels for rebabbiting bearings in the motor repair shop of the Clarence W. Silver Company. Net Result: a saving of approximately 35% in machining time on bearings "poured" in this manner.

All babbitting operations are performed on a special table and hood designed for this purpose. The unit is 49 inches long, 25 inches deep and has a working surface 33 inches above floor level. A sheet metal hood, connected to an exhaust system, covers the right half of the table. Under this, the metal is melted in a ladle cradled in a supporting metal ring over a gas burner.

Bearings are poured on the 24-inch square open space at the left side of the table. At the center point of the ½-inch thick metal table top, a ⅜-inch diameter steel pin projects ½-inch above the surface. This fits snugly into a precision-drilled hole in the base of each tapered mandrel (mandrels taper from top to bottom). The pin centers the mandrel and keeps it securely in place during the pour.

Proper centering of mandrel and bearing is assured by a series of concentric guide circles scribed on the metal table. Radius of the smallest circle is one inch (from center of mandrel pin). Radii of the other circles increase in one-inch steps (radius of circle No. 6 is 6 inches).

To set up for an actual pour, the correct size mandrel is selected and placed over the pin. The bearing is placed over the mandrel, aligned with the proper guide circle, and fitted with a clay retaining dam at the base. The molten metal is then poured between the mandrel and bearing. After the metal has hardened, the mandrel is removed (taper makes this easier) and the Babbitt lining machined.

A set of 15 mandrels are stored in a tilted angle-iron rack under the babbitting table. These vary in diameter and length to fit bearings ranging from ¾-inch to 3-inch inside diameter. Morgan finds this assortment takes care of most bearing work.

ADV.

IRVINGTON
INSULATING VARNISH DIGEST

Internal Curing Type Of Varnish Results in Complete Drying and Integrated Windings

Conductors are held in a compact homogeneous mass, free from wet, tacky interiors when impregnated with any of Irvington's internal curing varnishes.

These varnishes assure deep penetration and thorough curing, while at the same time permitting the use of fast, money-saving baking schedules. Range of types available permits selection to meet specific requirements such as: high oil and heat resistance; complete oilproofness; exceptional mechanical strength; long life at high temperatures; extreme resistance to chemical attack.

Motor repair shops dip stators and armatures in Irvington's internal curing varnishes for deep penetration, fast curing throughout and strong conductor bonding

Special Binder Used in Slot Insulation

A newly developed binder for bonding a fibre backing to flexible varnished insulation makes it possible for Irvington to produce a slot insulation with mechanical strength needed to withstand forming to fit any type of motor slot. Used in Irvington's IRV-O-SLOT cell insulation, this binder has the "give" necessary to prevent rupture of the varnish film during the forming operation. The binder does not harden with age nor ooze out under the effects of heat. Both shelf life and service life are greatly increased.

Motor Repair Shops Face Growing Demand For Rewinds with Class "H" Insulation

Design Trend to Use of High-Temperature Materials Points Way to Need for Same Insulation in Repairs

The reduction in frame sizes and the increased overload capacity made possible by motors designed for the use of Class "H" insulation have led to the increased use of materials of this type by electrical manufacturers. More and more of these motors, in which the insulation is capable of withstanding continuous operation at 175° C., are now in use throughout industry. While an outstanding characteristic of these motors is their ability to withstand high ambient temperatures or heavy overloads, it is natural that their windings may fail under conditions of severe abuse. Motor repair shops and industrial maintenance departments will therefore be faced with an increasing need to rewind these motors with the same Class "H" insulations with which they were originally wound.

For long life at 175° C., phase coils and slot cells of this motor are insulated with Irvington Class "H" Silicone Varnished Fiberglas

Oilproof Finish Coats Improve Rewind Jobs

For extra protection of motor windings against the harmful effects of oil, grease, moisture and chemicals, a finishing coat of quick-drying enamel can be easily applied by a dip, spray or brush-on operation to windings already impregnated with Irvington Insulating Varnishes.

Irvington Red Enamel No. 32 is commonly used where fast drying time, consistent with good protection, is desired; No. 30 Red is preferred when service conditions are exceptionally severe.

Irvington Red Enamels are easily brushed on, give added protection against oil, grease, dust

Types of Class "H" Insulation

Class "H" insulation consists of inorganic materials, such as Fiberglas* or asbestos, treated with silicones or other high-temperature materials. The Irvington Class "H" insulations most commonly used in motor manufacture, and hence most commonly required in Class "H" rewinds, include:

Silicone Varnished Fiberglas, Silicone Coated Asbestos, Silicone Saturated Asbestos, Silicone Rubber Coated Fiberglas, Teflon** Coated Fiberglas, Silastic®*** Tape, Silicone Rubber Coated Fiberglas Tubing, Silicone Coated Novabestos****.

All of these Irvington Class "H" insulating materials retain their excellent physical, chemical and dielectric properties under continuous operation at elevated temperatures.

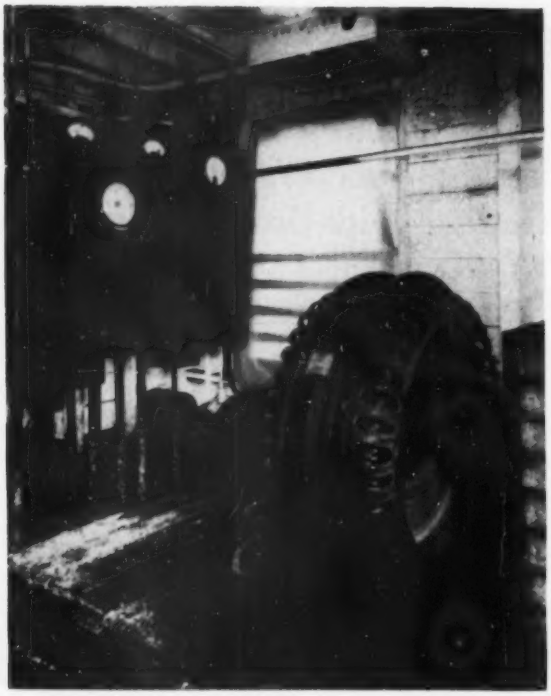
In addition, the wide range of Irvington materials permits the rewind of Class "H" motors so that they will meet other severe operating requirements. For example, Silicone Rubber Coated Fiberglas and Silastic® Tape remain flexible at temperatures as low as —70° F. and, Silicone Varnished Fiberglas resists moisture.

Corrosive Atmospheres

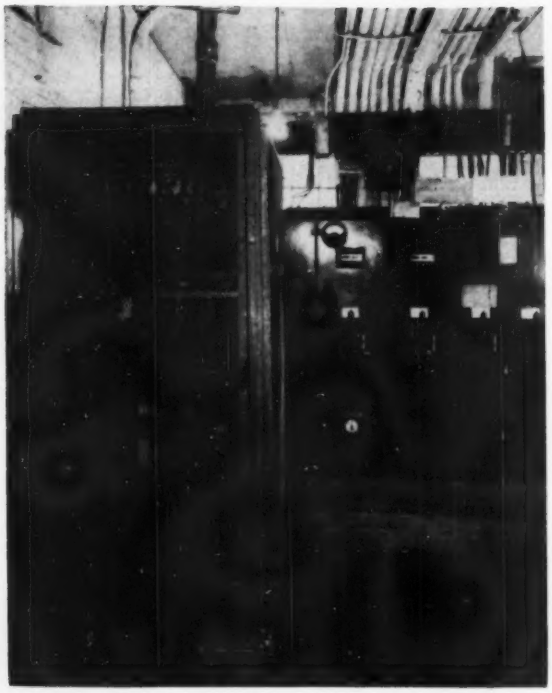
For applications where corrosive atmospheres are involved, Teflon Coated Fiberglas is commonly used. This insulation possesses an exceptional degree of chemical inertness, is low in water absorption, unaffected by outdoor weathering. Send for your free copy of Irvington's Class "H" Insulation booklet.

* ®Owens Corning Fiberglas Corp., ** ®du Pont de Nemours, *** ®Dow Corning Corporation, **** ®Raybestos-Manhattan, Inc.

For further information, write the Sales Manager, Varnish Dept., Irvington Varnish & Insulator Co., 18 Argyle Terrace, Irvington, N. J.)



75-HP SYNCHRONOUS MOTOR drives Jordan engine in a New England paper mill, producing constant speed regardless of voltage fluctuations and improving pf in the plant.



BANK OF 210-KVA 550-volt 3-phase shunt capacitors located near this switchboard brings pf in the plant nearly up to unity.

ELECTRIC CONSERVATION Through Power Factor Correction... part 2

An analysis of various types of utility power rates and of how these charges may be reduced by improving the pf in an industrial plant.

By N. A. Maynard, Westinghouse Electric Corporation, Boston, Mass.

FOR purposes of analyzing different types of utility power rates, let us consider an industrial plant with a day load averaging 960-kw and a power factor of 67%. Peak loads run up to 1200-kw, with corresponding power factors going to 75%. It is obvious that a large magnetizing current will be drawn from the line, and considerable savings may be made by supplying this magnetizing current with capacitors. Size of capacitors and associated advantages can be determined by systematic analysis. This involves an examination of various rates, relating them to pf.

Four types of rates are considered, in which (1) pf is not considered, (2) pf is taken into account through a demand charge, (3) pf is initially checked by test and is thereafter used as the basis for determining energy charges, and (4) pf is determined by determining kwh and kvar-hours, using these data to affect demand charges, energy charges, or both.

If pf is not included in the rate, capacitors still can be used to obtain savings such as reductions in circuit current, transformer loads and loads on customer-operated generators. Locations of capacitors will usually be near low pf loads, or on the circuits to be relieved. The size of unit can be determined by calculating the reactive kva, then using a capacitor large enough to supply all or part of it, thereby reducing circuit current to the desired figure.

IT'S HERE...The sensational new Paragon 3000 series time switch

NOW, the greatest name in time switches brings you the most advanced time switch ever offered anywhere. It's the Paragon Memory-Master — brand new inside and out — the product of five years of intensive research and development . . . and backed by 50 years of experience in time-switch design and manufacture.

You've never seen a time control with so many "look ahead" features . . . the "Quick-Out" movement — locked in — yet quickly removed with no loose parts . . . the "E-Z Turn" Dial that enables you to "run through" switching operations manually . . . the "Moto-Vu" operating window that permits an instant check of motor operation . . . and many other features.

Ask your distributor to show you this great new switch.

CHECK THIS SCOREBOARD

Feature for feature, you can't beat Paragon

FEATURE	PARAGON	MAKE "A"	MAKE "B"	MAKE "C"
Quick-change, easy-add dial trippers. No need to remove dial.	YES	YES	NO	YES
"Torsion-Clutch" Dial drive: permits manual check of switching.	YES	NO	YES	YES
"Quick-Out" movement: rattle-proof, positively fastened.	YES	NO	NO	NO
Motor operating indicator.	YES	YES	NO	NO
Double-Plate, long life movement.	YES	NO	YES	NO
Observation window in case cover.	YES	NO	NO	NO
Super-rigid case: 18 gauge or heavier.	YES	NO	YES	NO
U. L. approved for 30 amp switch capacity at 120 or 240 volts.	YES	NO	NO	YES

And best of all . . . you get all these features plus LOWEST PRICE . . . from **$10.50** list

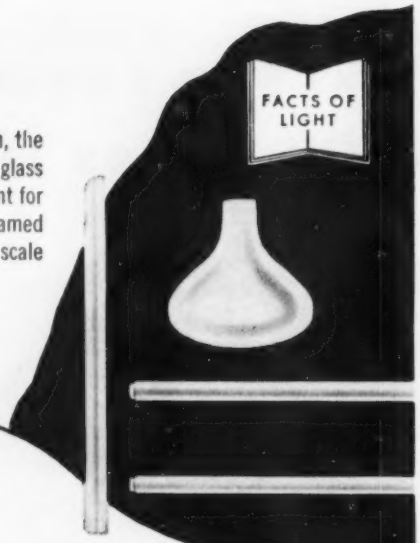
PARAGON ELECTRIC COMPANY

1614 12th STREET • TWO RIVERS, WISCONSIN

©1953

THE SWITCH THAT REMEMBERS . . . AND LETS YOU FORGET

Within one man's life span, the age of light really began when a glass bubble was blown around a filament for a man named Edison at a place named Corning. It got going on a production scale just about the time Champion Lamp Works was founded.



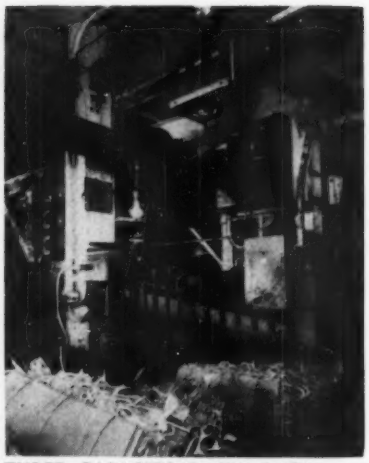
CHAMPION **The glass of a *Champion***

Now, today's "ribbon" machine turns out a million incandescent bulbs a day to glass wall thickness tolerances of no more than .0075". Fluorescent tubes are blown and drawn to outside diameters not more than .038" from standard.

Glass for Champion Lamps is truly a marvel of modern chemistry and production control. It must be strong and resistant to the attack of water, chemicals, fumes, grit, wind and flame. It must keep Champion Lamps ready to light up at the flick of a switch — ready to perform like Champions.

May we mail you a copy of the new booklet A entitled CHAMPION QUALITY? It contains many interesting facts and illustrations.

CHAMPION LAMP WORKS
Lynn, Massachusetts
A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO.



THREE CAPACITORS ON RACK near ceiling improve poor pf caused by comparatively slow speed motor driving beater in paper mill. Capacitor bank is switched with the motor, therefore is on the line only when needed.

Where pf is low, demand will be high and, if rates include a kva demand charge, this may be reduced by raising the pf during demand peaks. For example: with a demand of 1200-kw and a pf of 75%, the kva demand is $\frac{1200}{.75} = 1600$-kva. However, if the pf is raised to .95, the demand kva becomes $\frac{1200}{.95} = 1260$-kva. The size of capacitor required to accomplish this is the difference between the reactive kva at the two pf values.

At .75 pf this reactive kva is $\sqrt{1600^2 - 1200^2} = 1060$

At .95 pf this reactive kva is $\sqrt{1260^2 - 1200^2} = 387$

The rating of the required capacitor is therefore 1060−387 or 673-kva.

Reduction of kva demands from 1600 to 1260 may result in a reduced demand charge, or may actually reduce the energy charge, depending upon rate structure. This is true since most rates consist of decreasing charges for successive blocks of power, the size of the block being determined by kva demand. One example is as follows:

First block is billed at 5 cents per kwh, 2nd block at 1¼ cents per kwh, 3rd block at 1 cent per kwh and all additional current at ¾ cents per kwh.

It is plain that, if the kva demand is small, the size of block will be correspondingly small. Therefore the customer would reach the lower rate sooner and a larger proportion of the energy consumed would be billed at this lower rate.

Where test checks are made to establish an average pf under day loading

MORE WIRING SPACE

IN THIS NEW SQUARE D METER SOCKET

COMPARE THIS NEW METER SOCKET—*feature for feature*

More Wiring Space because (1) hubs are cast on *outside* of socket and (2) compact design of insulated mounting base.

Simple Installation—Lines up with other Square D equipment for better appearance.

Reversible Jaws can be positioned for either vertical or horizontal mounting—in the field—without special tools.

5th and 6th Jaws can be easily added—in the field.

MEETS EEI and NEMA STANDARDS—Available with either 2 or 3 hubs, with or without back breakout. Also with one hub and threaded rear opening.

Another example of Square D's DESIGN LEADERSHIP

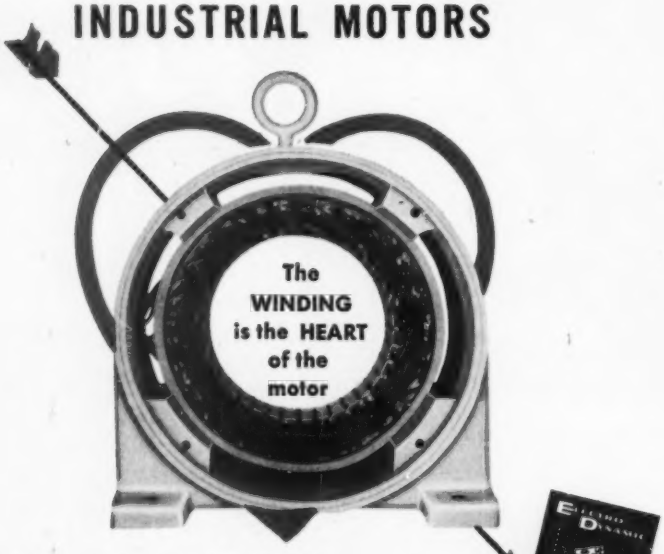
ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

SQUARE D COMPANY

1903 • **50** YEARS OF DESIGN LEADERSHIP • 1953

ELECTRO *xtra* DYNAMIC *ependable*

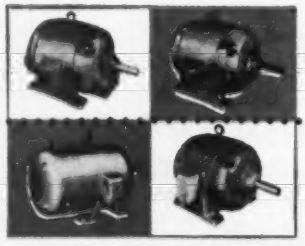
INDUSTRIAL MOTORS



Every Electro Dynamic motor is built with
EXTRA INSULATION in stator slots and between phases
EXTRA IMPREGNATIONS and bakings of the wound stator
EXTRA HIGH-FREQUENCY TESTING of insulation between turns

WRITE TODAY FOR CATALOGUE NO. 971

From 1 to 250 Horsepower (N. E. M. A. STANDARDS)


One-piece cast iron frames.
Extra large "free-flo" air channels.
Permanently aligned cast iron brackets.
Liberal size grease lubricated bearings.

Also a complete line of Direct Current motors and generators

ELECTRO DYNAMIC
DIVISION OF GENERAL DYNAMICS CORPORATION
BAYONNE, NEW JERSEY

BANK OF SHUNT CAPACITORS is connected across terminals of this 3-kc generator supplying melting furnace. Capacitance tunes furnace and generator inductance, providing full output of maximum efficiency with minimum internal heating of generator.

conditions, it is important to know how these checks are made. Plant owners can then install capacitors to raise pf as high as expected savings warrant. Then, after capacitors have been installed, the utility can be requested to perform a second check of the pf and set up a new billing rate accordingly. Capacitors are usually selected in proportion to day load requirements. In the case just cited, with the day load averaging 960-kw at 67% pf, a 720-kva capacitor would be necessary to bring the pf up to 95%. This is proved by the following:

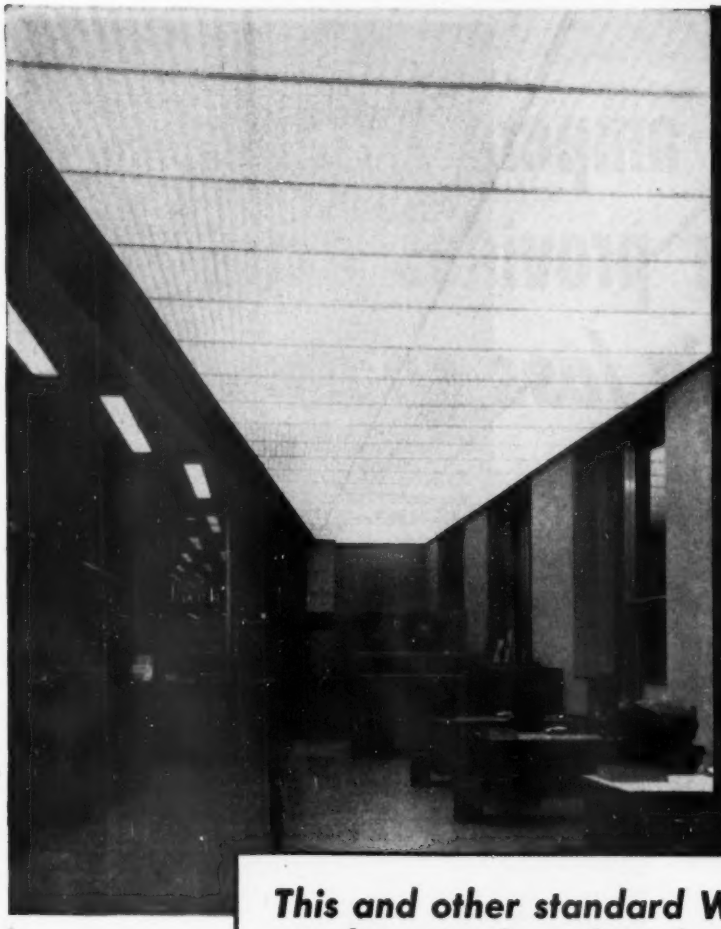
Demand kva at .67 and .95 are $\frac{960\text{-kw}}{.67}$ and $\frac{960\text{-kw}}{.95}$ or 1430-kva and 1010-kva respectively. Reactive kva are then $\sqrt{1430^2 - 960^2}$ and $\sqrt{1010^2 - 960^2}$ or 1035-kva and 315-kva. The reactive capacitor would then be 1035 — 315 or 720-kva.

The method most commonly encountered in industrial plants today is one taking into account monthly pf values obtained by integrating kwh and kvar-hours.

Assume that the plant mentioned above is billed for 322,250 kwh and that kvar-hours equal 346,000. This ratio amounts to a pf of 68%.

Let us also assume that rates indicate the desirability of reducing the kvar-hours to a point corresponding to .95 pf. That is, to $\frac{322,250}{.95}$ or 339,000 kvar-hours.

Reactive kva at .95 pf would then be $\sqrt{339,000^2 - 322,250^2}$ or 106,000 kvar-hours. This analysis indicates



This unusual non-rectangular installation shows flexibility of the WAKEFIELD CEILING

This and other standard Wakefield Ceilings can be priced on the job . . .

Here in this attractive bank installation the adaptability of the Wakefield Ceiling is apparent. A trapezoidal area is handled as readily as any normal rectangular area. Installation is simple because a standard Wakefield channel system is used above the Plexiglas diffuser. Note how advantageously fusion strips have been used under the rows of lamps to give extra shielding. Area is 1080 sq. ft. with 50 ft. c. maintained (walls of 50% and floors of 30% reflectance).

Though the Wakefield Ceiling in this installation is limited functionally to the provision of efficient lighting, it could have been furnished with acoustical baffles for sound control and further utilized as a means of air diffusion. The price of a Wakefield Ceiling can be figured by Wakefield representatives from plans or on the job anywhere. The F. W. Wakefield Brass Company, Vermilion, Ohio. In Canada, Wakefield Lighting Ltd., London, Ontario.

Wakefield Over-ALL Lighting

NEW I-T-E 225-amper "J" frame circuit breaker provides extra versatility... *in less space*

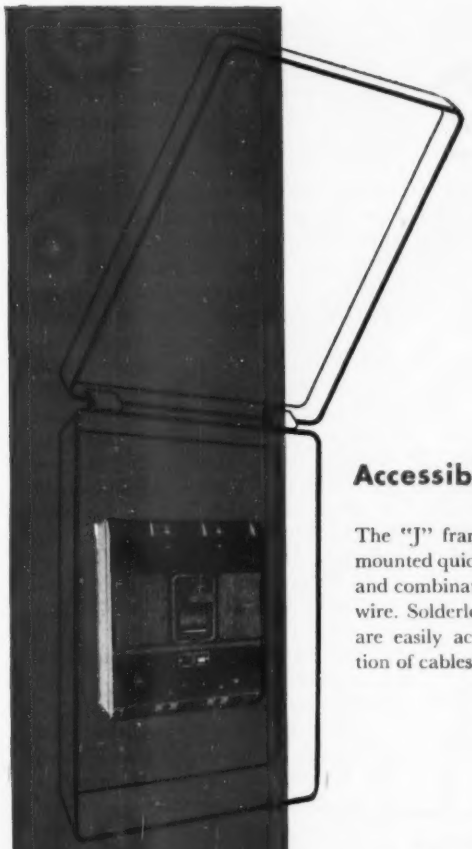
Shorter by *4 1/2 inches* than the plant-proved I-T-E "K" frame circuit breaker, the compact new "J" frame still provides the same outstanding protective features.

In switchboards, distribution-type panelboards, power panels, bus plugs, combination motor starters, and all types of individual enclosures—the "J" frame cuts space requirements considerably.

The "J" frame circuit breaker operates on common trip principle; an overcurrent on *any* pole opens *all* poles simultaneously. Mechanism is quick-make, quick-break—trip-free. Thermal-magnetic tripping provides complete protection against overloads and short circuits. Three-position operating handle visually indicates when the circuit breaker is ON, TRIPPED, or OFF.

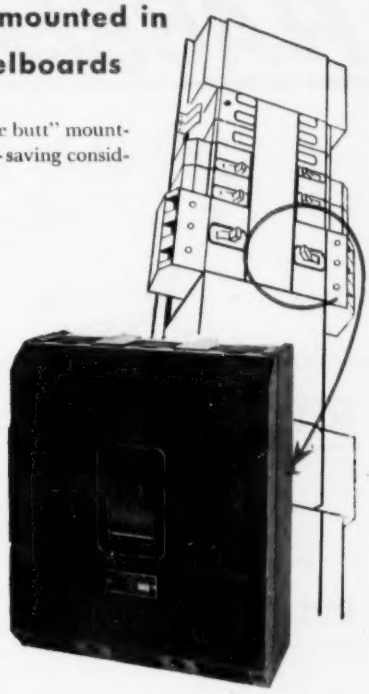
Special auxiliary devices—shunt trips, undervoltage trips, auxiliary switches, and alarm switches—can be mounted *within the circuit breaker case.*

I-T-E MOLDED CASE



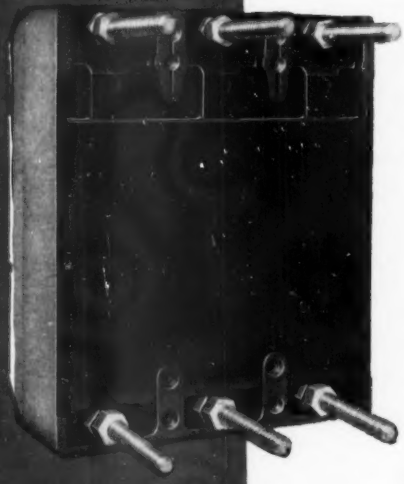
Now...two 225-ampere breakers can be parallel-mounted in convertible panelboards

Reduced size allows "double butt" mounting of "J" frame breakers—saving considerable space.



Accessibility is increased

The "J" frame circuit breaker can be mounted quickly in individual enclosures and combination motor starters. Easy to wire. Solderless, pressure-type terminals are easily accessible for quick connection of cables.



Switchboard mounting is simplified

by use of rear connection studs. Easy front removal of breakers. Safe. Saves time.

Available in ratings from—

70 to 225 amperes
2- and 3-pole (3-pole case construction only)
600 volts a-c
250 volts d-c
15,000 amperes interrupting capacity—NEMA

Save time, save space . . . without sacrificing quality

Standardize on I-T-E circuit breakers to assure service continuity, simplified maintenance, a single source for system expansion or replacements, and—*always*—the same proved I-T-E dependability throughout. *I-T-E Circuit Breaker Co., 19th and Hamilton Sts., Philadelphia 30, Pa.*

I-T-E CIRCUIT BREAKERS

THE AD MAN WAS FLABBERGASTED

THIS AD MAN had spent 20 years dealing with the technical facts of industrial products. He knew most of the angles and their answers. Shown a small Rawlplug, he figured it could resist a "pretty strong pull."

SURPRISE!

Then we gave him a demonstration... a #12 Rawlplug with a #12 screw set in concrete. Attaching a jack and scales we applied a direct pull. Up went the indicator... 500, 1000, 1500 lbs. The Rawlplug held firm. We applied more pull, and still more, till finally the plug started to creep. The indicator stood at 2200 lbs. and the ad man was flabbergasted!

EVERYTHING!

The fact is, that Rawlplugs and other Rawlplug devices are absolutely tops for holding power... have a safety factor many times in excess of most anchoring requirements.

And on top of that, the famous Rawlplug line is *complete* and enables you to meet virtually every anchoring demand of every customer and prospect.

YOU WIN!

The Rawlplug line is sold only through distributors. The line is constantly being developed... and effective advertising describes its unique advantages to everyone who counts in your area.

Write for the whole Rawlplug story... it can boost your sales and win brand new friends.

RAWLPLUGS
Fibre screw anchor for use with wood or lag screws. Only universal anchor that can be used in any material.
Wood screw sizes #6 to #20
Lag screw sizes #3/8 to #5/8

RAWL-ANCHORS
Heavy duty masonry anchor of "confined lead type" for holding bolts. Made in one piece—double ended—cannot be misapplied.
Bolt sizes 1/4" to 1"

RAWLDRILLS
Three point easy-to-sharpen masonry drills for hand and power drilling. For Rotary drilling—use Rawl Carbide tipped drills.

RAWL-TAPERS
The improved machine screw anchor. The taper permits use in undersized holes, resulting in saving of drill costs.
Machine screw sizes—6 x 32 to 3/8 x 11

RAWL-DRIVES
Only expansion bolt combining anchor and bolt in one piece. Simple to use, easy to install. Drives like nail into drilled hole. Tremendous holding power.
Sizes 3/16" to 5/8"

RAWL HAMMER-SETS
Newest type of heavy duty machine bolt anchor. Hammer is only tool needed to set it permanently in the masonry.
Bolt sizes—3/16" to 5/8"

RAWL TOGGLE BOLTS
For simplicity of installation and security of anchoring any fixture or utility in hollow walls or ceilings.

THE
RAWLPLUG Co., Inc.
271 Church St., New York 13, N.Y.

that several capacitor sizes might be required.

Going back to the first rate condition, where pf is not considered, the installation of one or more capacitors, or no capacitors at all might be indicated. The answer would have to depend upon an analysis of plant circuit loads, transformer loads, voltage regulation and similar data obtained from plant engineers familiar with load conditions. For example: an overloaded transformer might be relieved by installing capacitors rather than purchasing a new transformer. Adding additional loads to an existing 180-cycle generator might also be desirable.

Under the second rate condition, where a reduction in demand charges is desired, a 673-kva capacitor would be required. The cost of this unit should be weighed against resulting savings.

In the third rate case, where the day load pf is raised to 95%, a 720-kva capacitor is indicated.

The fourth condition would involve a capacitor capable of bringing the monthly integrated pf up to 95%.

Under the fourth condition just mentioned, let us assume that 550-kva will be sufficient to raise the monthly pf to .95. Then, having determined this value, we must consider an additional question: since part of the capacitor capacity will not be needed during week-ends or light load periods, will it be possible to reduce its kva or cut it off entirely at such times?

There is nothing gained by leaving all capacitors on continuously, except savings associated with attendance or the cost of automatic cut-off switches.

However, if the capacitor is left on, the boost in voltage caused by the capacitor, superimposed on an already high voltage caused by no-load conditions, might either raise the voltage to a value that might exceed the operating limit of the capacitor or cause reduction in lamp life. The point at which voltage will be excessive can easily be computed.

Calculate Your Savings

While rates throughout the country vary considerably with respect to methods used for taking pf into account, the following is fairly typical.

1) Scope of schedule—5 kva to 18,000 kva.
2) Demand charge—1st 2 kva of billing demand is $5.50; next 3 kva at $2.10 each; next 25 at $2.00; next 70 at $1.50; next 200 at $1.00; next 700 at $.50 and all kva of billing demand over 1000 at $.25 each.

PWC
ELECTRICAL WIRES, CABLES & CORD SETS
PWC ~ #6 A-Z TYPE UF UNDERGROUND FEEDER
PWC ~ 12/2 A-Z TYPE NMC AND TYPE UF
PWC ~ 12/3 A-Z TYPE NMC AND TYPE UF
MULTI-PURPOSE
A-Z ®
NON-METALLIC SHEATHED CABLE
THE CABLE WITH THE FUTURE

A-Z Type UF Underground Feeder Cable is the first thermoplastic cable recognized by the National Electrical Code and the Underwriters' Laboratories for direct earth burial in branch or feeder circuits.

RECOGNITION OF A-Z CABLE IN 1953 REVISION OF NATIONAL ELECTRICAL CODE

Single Conductor A-Z Type UF	
1. For direct earth burial as feeder cable.	Sections 3102.b and 3392
2. For direct earth burial in branch circuits.	Sections 3102.b and 3392
Multiple Conductor A-Z Type UF	
1. For direct earth burial as feeder cable.	Sections 3102.b and 3392
2. For direct earth burial in branch circuits.	Sections 3102.b and 3392
3. For interior wiring in wet locations.	Section 3392
Multiple Conductor A-Z Type NMC	
1. For interior wiring in damp locations.	Section 3362.b
2. For interior wiring in corrosive locations.	Section 3362.b
3. Embedded in plaster.	Section 3362.a and b
4. Installed in outside masonry block walls.	Section 3362.a and b
5. Installed in dry locations.	Section 3362.a and b

Write for A-Z Catalog

PLASTIC WIRE & CABLE CORPORATION

JEWETT CITY, CONN.

3) Energy charge—1st 1000 kwh at 1.7 cents per kwh; next 80 kwh per kva of billing demand at 1.5 cents and all additional kwh at .5 cents per kwh.
4) Meters used include a kwh meter with a 15 minute demand attachment, and a kvar-hour meter.
5) Kva of billing demand is

$$\text{kw}\sqrt{1+\frac{(\text{Kvar-hours})^2}{(\text{Kwh})}}$$

It will be noted that, in the above example, kvar-hours for the month and kwh for the month are used to determine the kva demand. Such kva demand is called the Billing kva demand.

With the typical rate just discussed and with the indicated consumption values, billing would be as follows.

Kwh consumed per month..	322,250
Kvar-hrs consumed per month	346,000
Kw demand	1,200

Billing kva demand is

$$1200\sqrt{1+\frac{(346,000)^2}{(322,250)^2}} \text{ or } 1755 \text{ kva.}$$

Demand charge figured according to the typical rate is $905.55
Energy charge is $3027.25
Total Demand and energy charge is $3932.80

Since this power rate emphasizes the ratio of monthly kwh and kvar-hrs, a 550-kva capacitor would be used, giving .95 pf and reducing kvar-hrs from 346,000 to 106,000. After the capacitor is installed the bill would be as follows.

Kwh consumed per month..	322,250
Kvar-hrs consumed per month	106,000
Kw demand	1,200

Billing kva demand is

$$1200\sqrt{1+\frac{(106,000)^2}{(322,250)^2}} \text{ or } 1260 \text{ kva.}$$

Demand charge is $781.80
Energy charge is $2631.00
Total demand and energy charge is $3412.80
This shows a total annual savings of $6240 of which $1485 is obtained through reduction of demand charges and $4755 is from energy charge reductions.

Since the cost of a 460-v 550-kva capacitor is $4200, the cost of the capacitor would be returned through savings in less than 9 months.

Investigation of the established relation between pf and electrical rates in any particular region and computation of costs similar to the above will make evident the savings possible through pf correction.

On-the-job photo,
Ace Day & Night Electric Co.

"60% man-hour savings...15 to 20% materials' savings with Greenlee Hydraulic Bender"

Here's how you trim costs immediately with a GREENLEE Hydraulic Conduit Bender on the job. It saves man hours. It saves materials. It speeds and smooths up the installation in several ways.

This has been proved over and over again through experiences such as reported by Ace Day & Night Electric Co. of Inglewood, California. When they recently used a Model 770-T to bend 1-1/4", 1-1/2" and 2" tubing for installation in the Los Angeles Exposition Building, they commented as follows:

"About 60% savings in man hours by the use of the GREENLEE Bender. Elimination of material spoilage results in additional savings of 15%. Also, a saving of approximately 5% through not requiring fittings. And using the bender eliminates need for *any* manufactured bends."

Let the GREENLEE Bender make important savings on your jobs, too. With it *one man* quickly makes smooth, *accurate* bends in pipe and conduit up to 5", thin-wall conduit, tubing, bus-bars. Compact, portable . . . easily carried to the job and set up exactly when and where needed. Write for facts today. Greenlee Tool Co., 1749 Columbia Avenue, Rockford, Illinois.

TOOLS FOR CRAFTSMEN
GREENLEE

OTHER GREENLEE TIMESAVING TOOLS FOR ELECTRICAL WORK

Hand Benders • Knockout Tools • Auger Bits and Drills • Cable Pullers • And Many More

SO SIMPLE

NO PINS • NO PIVOTS • NO BEARINGS

No Wonder There's No Trouble

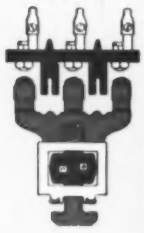
In any device it's the moving parts that are the troublemakers. The more moving parts . . . the more chances for trouble.

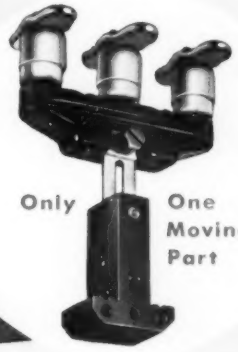
Most motor starters have lots of moving parts like pins, pivots, bearings, and linkages. But . . . Allen-Bradley Bulletin 709 solenoid starters and contactors have ONLY ONE MOVING PART . . . the solenoid plunger which carries the movable contacts. No switch could be simpler . . . nor more trouble free. The silver alloy contacts need no filing or dressing. They are always in good operating condition.

The Bulletin 709 general purpose enclosures, shown below, have a bonderized, black enamel exterior finish that is corrosion resistant. The white interiors make installation and inspection easy in dark places. All switch parts have a "quality" finish. In fact, you cannot buy better "quality looking" control.

Special enclosures are available for every kind of service condition. These across-the-line starters can also be furnished in "open type," without enclosures, for mounting in machine base. Let us send you our catalog!

CONTACTOR OPEN





CONTACTOR CLOSED

Send for Illustrated Bulletin

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.

COMPLETE LINE

Allen-Bradley Bulletin 709 Across-the-line Starters are listed for 3-phase motors up to 600 hp, 440-550 v. All starters have accurate relays for overload protection.

ALLEN-BRADLEY

TROUBLE FREE MOTOR CONTROLS

7-53-MR

LOOK! Air Break Contacts for Motors up to 150 hp, 440-550 v

When you buy a manually operated autotransformer starter, don't overlook these advantages of the Allen-Bradley Bulletin 646 Starter:

In addition to time-delay switchover and dependable overload relays, the Bulletin 646 Starter is listed with *air break contacts* for ratings up to 75 hp, 220 v; 150 hp, 440-550 v. Oil is messy and should be used only where atmospheric conditions require it. These starters can be furnished with oil-immersed contacts, if desired.

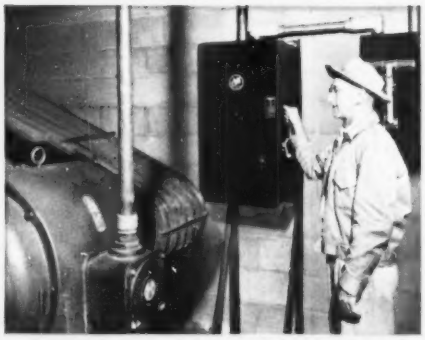
Allen-Bradley double break, silver alloy contacts need no cleaning, filing, or dressing. This saves labor and lengthens contact life. Starting voltage taps are easily adjusted to suit starting conditions. Time delay undervoltage release is optional.

Bulletin 646 autotransformer type starters are available in NEMA Type 1, Type 4, and Type 9 enclosures. For full details write for Bulletin 646, a 12-page booklet with dimensions and ratings up to 250 hp, 440-550 volts.

Allen-Bradley Co. 1316 S. Second St., Milwaukee 4, Wis.

ALLEN-BRADLEY

TROUBLE FREE MOTOR CONTROLS

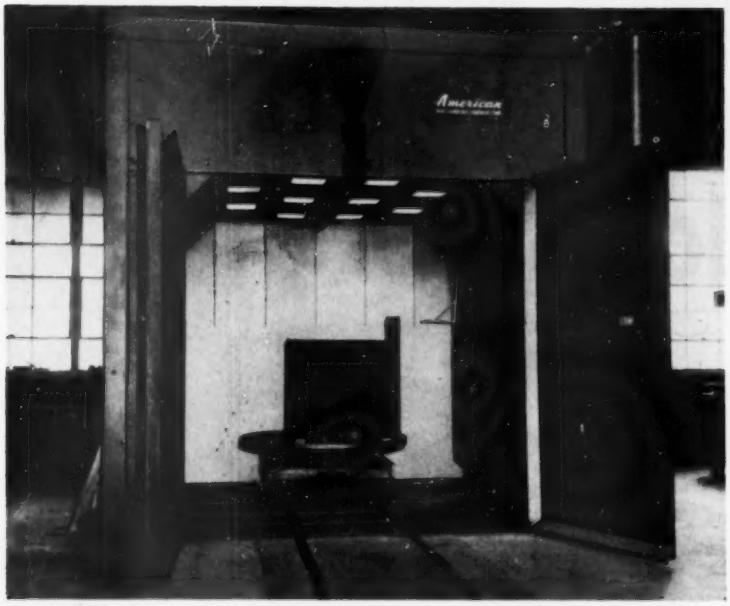


To start motor, operating lever is pulled into START position. Built-in automatic time delay prevents operator from immediately throwing lever to RUN position.

After motor accelerates, the time-delay trips. Operator can then . . . but not before . . . push lever into RUN position. If operator shifts too soon, operating lever must be returned to START.

7-53-M

Motor Shops



ROTATING DOLLY, vapor-proof lighting, multi-port exhaust system, gravity salvage system, wall hooks, lipped doors and overhead monorail for chain hoist are features of this walk-in sand-blast chamber used by Daystrom, Inc.

Walk-In Blast Chamber Has Many Features

A large, walk-in sand-blast chamber, used by Daystrom, Inc., of Archbald, Pa., has many features of interest and benefit to motor shops. For example, parts to be cleaned are wheeled into and out of the chamber on a railed dolly equipped with a ball-bearing turntable. This table can be easily revolved as the sand blasting continues, making it easy for the operator to stand in one convenient location while he works, rather than making him walk around the object. Another means of moving equipment into or out of the room is by an overhead monorail, beneath which is an opening in the chamber's roof, normally sealed by stiff rubber flaps. Whenever a chain hoist moves along the rail, these flaps part sufficiently to permit free movement of the chain, yet fit snugly enough around the support to prevent dust or fumes from escaping from the chamber.

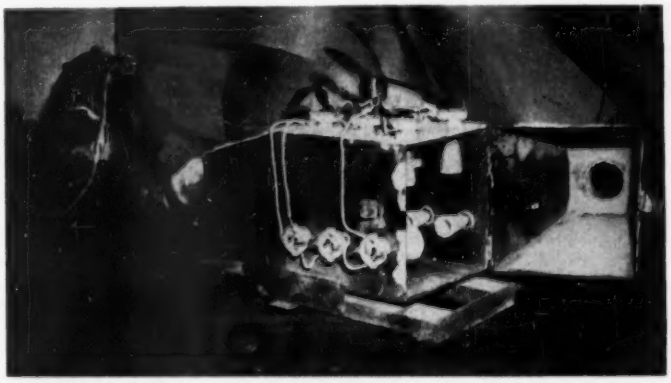
When working inside the chamber, the operator is protected by coveralls, helmet and rubber gloves. Sand particles fall through a subway-grating floor and are caught in a salvage hopper for recirculation through the sand hose. Dust is sucked upwards and out of the chamber by an exhaust system having numerous small ports distributed over the entire area of the roof, and lighting is provided by vapor-proof fixtures. Lips on the two bi-parting front doors are other features that confine dust within the enclosure.

When it is desirable to suspend objects along the walls rather than support them by the chain hoist or rotating dolly, series of hooks on either wall makes this possible.

Floor-Recessed Tank Impregnates Coils

Positive impregnation of insulating varnish into freshly wound coils is obtained in the shop of the Pennsylvania Electric Coil Corporation of Pittsburgh through the utilization of a floor-recessed tank having a depth of 6 feet and a diameter of 4 feet. This tank is equipped with a heavy hinged cover which is raised and lowered by means of a traveling electric hoist and, when the cover is in position, it is dogged down tightly by a dozen 1¼-inch toggle bolts. Within the enclosure, a vacuum of 28½ pounds may be created, or a positive pressure of 75 psi developed. Since the cover is also equipped with two thick glass viewing ports and an explosion-proof lighting unit, it is possible to observe the level of varnish within the tank at all times. Current for the lighting unit is supplied through a flexible cable.

In operation, coils are pre-baked then lowered into the tank by means of a large basket which is controlled electrically by a pushbutton station flexibly connected to the monorail hoist. All air and residual moisture is extracted by vacuum from these coils, then insulating varnish is admitted to the tank through supply lines entering the bottom of the enclosure. This varnish is forced into all interstices by pressure which is built up to its permissible maximum, then the varnish is forced back into its reservoir by opening the

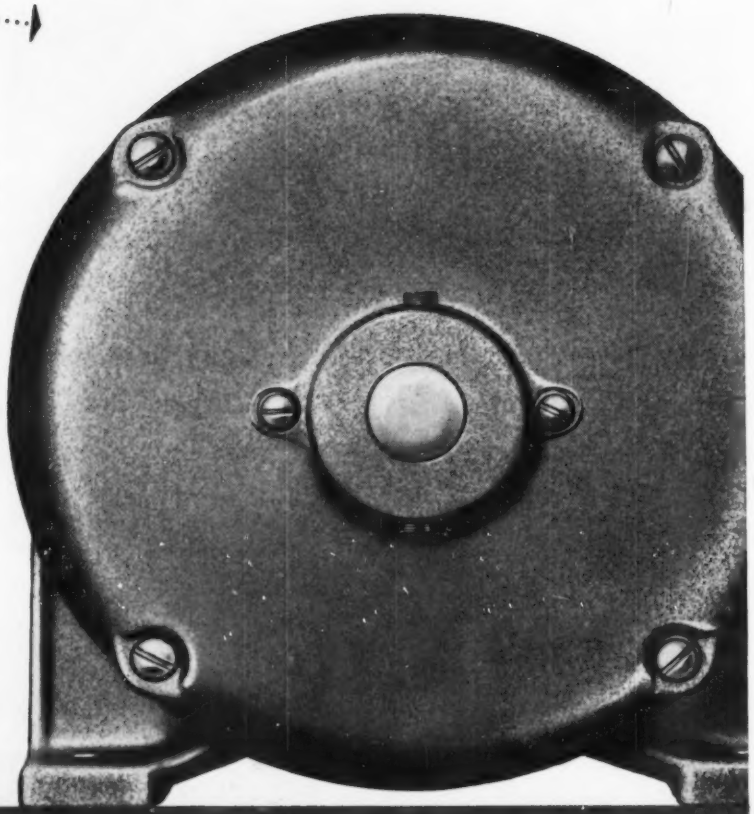


HOT AIR BLOWER is a handy piece of field equipment used by the Armature and Electric Machine Co., Omaha motor service shop for drying out electrical equipment damaged by moisture or flood waters. Motor-driven centrifugal blower forces air into "hot box" then through nozzle to which hose can be attached if necessary. Rectangular sheet-steel heating chamber has 12 cone-shaped electric resistance units (six on top and three on each side). Hinged nozzle at front can be opened to add or replace heating elements. Complete unit is mounted on channel-iron base; can be quickly loaded on truck and moved into place on the job.

DEPENDABILITY...
that builds dividends
Delco Motors

Delco integral motors are one item of manufacturing cost that does not come under the head of "variable." They are so consistently dependable in operation that they have a stabilizing effect on production costs—and on dividends.

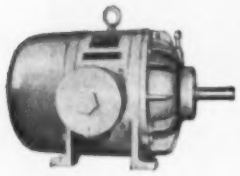
There are Delco motors for most applications—motors that will fit into **your** needs. A sales engineer from any one of the offices listed below will respond to your inquiry.



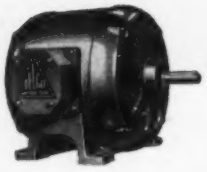
DELCO
DAYTON OHIO

DELCO PRODUCTS

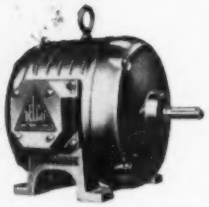
Division of General Motors Corporation
Dayton, Ohio



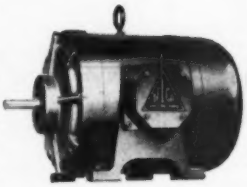
Explosion-Proof Motor



Open Ball-Bearing Motor



Totally Enclosed Motor



Totally Enclosed Fan-Cooled Motor

SALES OFFICES: Atlanta • Chicago • Cincinnati • Cleveland • Dallas • Detroit • Hartford • Philadelphia • St. Louis • San Francisco

ELECTRICALLY CONTROLLED hoist lowers basket containing new coils into floor-recessed tank where vacuum removes all moisture and trapped air, then pressure forces insulating varnish into the windings. This tank is equipped with viewing ports and explosion-proof light.

bottom feed valve. When this cycle is completed, pressure within the tank is dropped back to normal, the cover is un-dogged and raised, and the coils are transferred to racks for oven baking.

General illumination over this tank area is furnished by two-lamp 40-watt fluorescent industrial fixtures.

Triangular Tool Chest Fits Truck Chassis

Charles Buckley of Atlantic City, N. J., constructed his own tool chests for trouble-shooting purposes. The chests are triangular in shape, having a sloping cover which slants from the rear of the truck cab down to the floor of the truck body. Narrow shelves and bins are located in the upper section of the chest; wider ones at the bottom. Covers are hinged, and padlocked to prevent pilferage of equipment.

Constructed for a few dollars each, the chests are bolted down securely to the truck chassis, yet may be unbolted if it is desired to carry the equipment into a building or shift it to another vehicle.

TOOLS AND MATERIALS are carried on shelves and in bins constructed in this triangular-shaped trouble-shooting chest which fits snugly behind the cab of Charles Buckley's truck. Sloping, hinged cover slants from rear of cab to floor of truck body. Unit may be unbolted and lifted out if desired.

Simple Shop Rack Made From Conduit

In many motor shops, floor space is obstructed by various types of racks that are used only occasionally. When these racks are not in use they still require storage space and, when they are required, it frequently develops that their permanent location is not convenient to a particular service area. Both of these conditions result in a lessening of shop efficiency.

In the shop of the Pacific Electric Motor Company of Oakland, California, racks require practically no floor space when they are in use, no space whatever when they are not in use, and they may be shifted to various locations in accordance with local requirements.

Their construction is unusually simple, consisting merely of large-diameter conduits with steel hooks welded to them at various heights. They are supported by larger conduit inserts in the concrete floor. When not in use the hooked conduits are removed, and the floor inserts are capped to prevent debris from dropping into the openings. Since inserts are positioned throughout the shop at strategic locations, the vertical supporting members may be shifted to a number of work centers.

CONDUITS FITTED WITH HOOKS are supported by pipe inserts in the concrete floor. Racks may be shifted to various locations, spaced at different distances from each other, or removed.

The simplicity of this idea makes it possible to keep the floor uncluttered, to quickly erect a rack where it is needed, or to vary the distance between supporting members to accommodate armatures or other loads of varying lengths.

Jack-Plug Panel Provides Test Needs

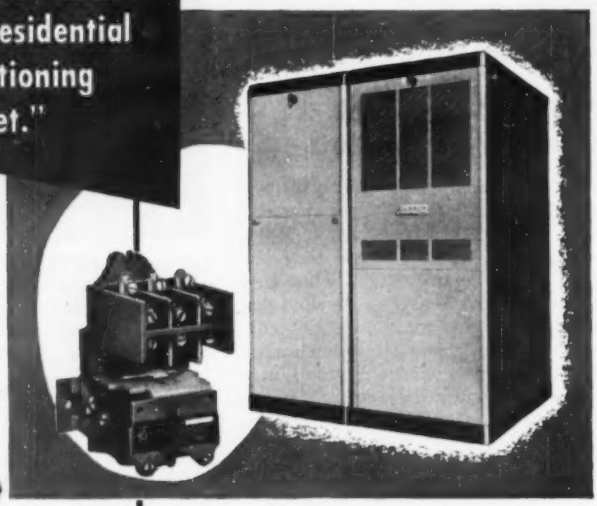
A simple, compact, jack-plug panel provides adequate motor test facilities at the Barberton, Ohio, branch repair shop of the Berthold Electric and Engineering Company. The multi-voltage, multi-phase unit is only 3-feet wide, 2-feet deep and 6-feet high; contains a 150-kva, 3-phase transformer with Scott connection for testing 2-phase equipment.

The upper half of the panel contains a total of 49 jacks in seven vertical rows (three on left for 3-phase, four on right for 2-phase) to provide multi-phase power at 55, 110, 200, 440, 550, 1100 and 2200 volts.

A double-throw knife switch on the base panel places the 3-phase jacks in the circuit when in the upper position. In the lower position, the switch energizes the 2-phase jacks on the right

Speaking of
FURNAS CONTACTORS
Lennox Furnace says, "Closest... to what we consider ideal for the residential air conditioning market."

KEEPING LENNOX HOME AIR CONDITIONING SYSTEMS
working efficiently and quietly is the job of Furnas Electric magnetic contactors. Frank Osborn, air conditioning engineer at Lennox Furnace Company, gives these reasons why he selected Furnas Electric contactors:



QUIET OPERATION:
Mr. Osborn likes Furnas Electric contactors because they are "relatively free of operating hum." He comments: "quietness... is of utmost importance in residential air conditioning applications."

EFFECTIVE PERFORMANCE:
Since residential air conditioning systems are subject to wide voltage fluctuations, Osborn points out that the Furnas Electric contactor has a big advantage with "its relatively low inrush and holding current characteristics."

LOW ORIGINAL COST:
The price of Furnas Electric contactors is hard to beat. Compared with other types, Mr. Osborn says this: "Furnas contactor is in a price and duty range more compatible with the residential appliance market."

These are important reasons why Furnas Electric contactors are especially suited for use on air conditioning systems. Proved in performance in a *wide range of applications,* Furnas Electric equipment has built a record that speaks with authority.

New Size 2½ Magnetic Contactor and Starter
Now being offered... another in-between size that saves you money and space. Available in reversing styles. Rated 20 hp at 208-550 v, 30 hp at 440-550 v ac polyphase; 5 hp at 110 v, 10 hp at 208-220 v ac single phase. Ask for bulletin on YG series.

Furnas Electric representatives are located in major cities coast to coast. For information and free bulletin describing the complete line of Furnas motor control equipment, write to Furnas Electric Company, 1067 McKee St., Batavia, Illinois.

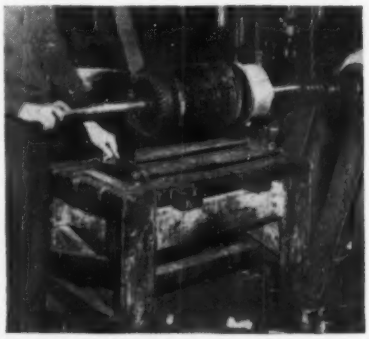
FURNAS ELECTRIC
Batavia, Illinois • Near Chicago

TEST PROCEDURE with compact jack-plug panel is demonstrated by shop superintendent Norman McCutcheon (left) and Paul W. Berthold, president, Berthold Electric and Engineering Company.

side of the panel. A clamp-on ammeter is used on the test leads to measure phase currents of the motor under test. Locked rotor, no-load and full-load running and excitation currents can be checked on motors up to 1,500 hp rating.

Adjustable Rack Supports Armature

A simple cradle for supporting armatures on the work benches in the shop of the Central Armature Works of Washington, D. C., is constructed from angle iron, strap steel, bar stock and short conduit sections. One supporting member is rigidly attached to the base of the cradle while the other supporting member is movable, thereby making it possible to quickly adjust the



SLIDING SUPPORT for armature shaft may be moved along horizontal rods, thereby regulating distance between V-shaped rests on this cradle assembly. Sliding support consists of short lengths of conduit, connecting strap and vertical member.

Underwater operation holds no peril for these Hazacord cables. Skid mounted junction box contains four 400 amp. circuit breakers . . . single cable leads from transformer bank; four branch circuits go to the control house near the shovel (below). The 500 horsepower motor which operates the pit-pump used for pumping the phosphate-bearing matrix to the washer also gets its power through Hazacords.

Grabbing 17 yards of phosphate rock in a single bite, this enormous dragline supplies raw material for fertilizers and chemicals produced by the Virginia-Carolina Chemical Corporation. Power is furnished by thousands of feet of Type SH-D, 5000-volt Hazacord cable.

Hazard's exclusive ZBF sheath—cured under pressure in a continuous metal mold—is one reason why Hazacord cable can take the rough treatment it gets being dragged over this rugged Florida terrain.

V-C CHEMICALS SELECTS

LONG-LIVED HAZACORD SHOVEL CABLES FOR RUGGED PHOSPHATE MINING OPERATION

Hazacord Type SH-D was used exclusively by V-C for this important mining job. The safest and most widely used type for high-voltage work, Hazacord Type SH-D has copper shielding braid over each insulated conductor . . . grounding conductors in the interstices. For use up to 15000 volts.

On *every* job . . . from a giant dragline to a portable electric saw, Hazacords are setting new standards for long, economical service from cords and cables. Get complete information from your Hazard representative, your jobber or write to us today. Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pennsylvania.

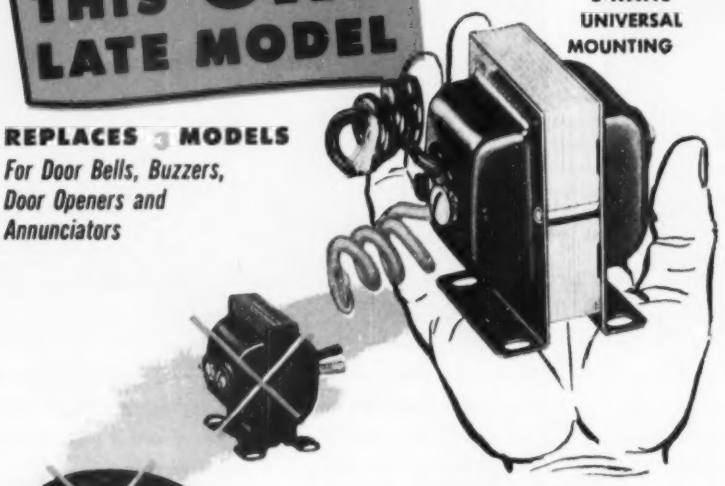
HAZARD HAZACORD *Mold-Cured* portable cables

1403

THIS ONE LATE MODEL

10-V SECONDARY
5-WATTS
UNIVERSAL
MOUNTING

REPLACES 3 MODELS
For Door Bells, Buzzers, Door Openers and Annunciators



FILL EVERY NEED
STOCK ONLY ONE MODEL

The one Jefferson Universal-Mounting WIZARD Bell Transformer for operation of *door bells, buzzers, annunciators* and *door openers* replaces THREE models. Patented mounting design feature provides easy and quick attachment to any outlet box, cover, or cabinet, with primary leads for connecting to circuit and terminals for bell wires. Mounting feet are also provided for open wiring installations. No special mounting plates are required. Ideal for close-quarter installations. Stocked by Electrical Wholesalers Everywhere.

Jefferson Chime Transformers are also equipped with the Universal Mounting Feature.

JEFFERSON ELECTRIC COMPANY, Bellwood, Illinois
In Canada: Canadian Jefferson Electric Co., Ltd., 384 Pape Ave., Toronto, Ont.

JEFFERSON Wizard
BELL TRANSFORMERS
APPROVED BY UNDERWRITERS' LABORATORIES

RELIABLE FUSE PROTECTION STOPS: Unnecessary Production Shutdowns and Motor Burnouts

In the widely used line of Jefferson Fuses you will find the type and capacity for all lighting and power circuit requirements. For general purposes—ask for Jefferson-Union Renewable or Gem non-renewables.

For long time lag on circuits with heavy motor starting loads use Jefferson Super-Lag Renewables, or the dual-element Jefferson SAF-T-LAG thermal type non-renewable fuse. Your wholesaler can supply you.

JEFFERSON FUSES

distance between the two supports for the accommodation of any size armature.

In construction, the base consists of end pieces formed from 12-inch sections of angle iron, with the horizontal flanges pointing outwards. These end sections are connected by 20-inch lengths of bar stock. Short lengths of conduit slide along these rods and, linking the conduit stubs, a cross member formed from strap steel is installed. Strap steel vertical members are attached to this sliding assembly and to one end piece, the vertical members being split at the top and spread to form V-shaped supports for the armature shaft.

Recommendations for Bearing Removal

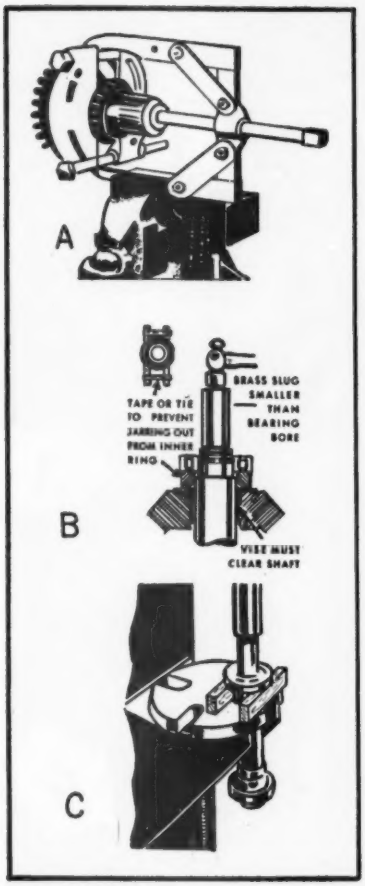
Three methods are generally used to remove or install bearings from their shafts: with a bearing puller, arbor press or drift pin. Of the three, the first mentioned method is the best and most satisfactory. Least recommended is the use of a soft metal drift, slightly smaller than the bearing, with the inner ring supported.

As recommended by the Anti-Friction Bearing Distributors Association, each bearing assembly should be studied before beginning a removal or installation job so that the best method can be used and damage to shaft or bearing avoided. It should be remembered that the outer race is usually installed with a tight fit, while the stationary race is usually loose and, when a piece of equipment is taken apart the bearing will cling most tightly to the member to which it is tightly fitted.

To remove the bearing, pressure should be exerted only on the ring that is tight, if possible. Pressure should be straight or square to keep the ring from cocking, as this might score the shaft or housing, or damage the bearing. Pressure should never be against separators or bearing shields.

Bearing pullers fit behind bearings or bearing rings and, when properly adjusted, cannot slip over inner rings to damage parts.

When using an arbor press, means should be provided to prevent the shaft from dropping to the floor. Also, when a shaft or bearing is so large that the shaft end cannot be squared up with the press ram, a self-aligning fixture between the ram and shaft can be made by turning up two steel blocks. The end of the shaft should also be protected by a pad of soft lead, copper or similar metal.



THREE METHODS are recommended to remove bearings from shafts: the puller (a) which fits behind the ring and cannot slip over the inner ring to damage it, the arbor press (b) with some means provided to prevent the shaft from falling, and a small, soft metal drift pin (c) with the ring supported by the jaws of a bench vise.

Where bearing seats are of the proper diameters and are without any sharp taper, the bearings should slide all the way to the shoulder with uniform pressure. When they do not slide smoothly, the source of the trouble should be located and corrected, since continued force on a bearing not started squarely might scrape or otherwise damage the bearing seat.

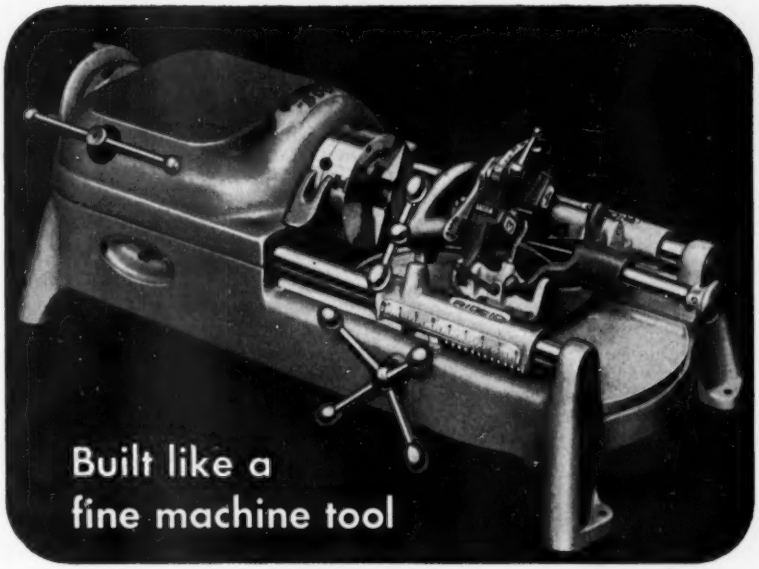
On larger bearings, inner rings are usually shrunk on their shafts, accomplished by heating the bearing or inner ring in clean oil which is controlled at a temperature range between 200- and 250-degrees F. This heating process expands the inner ring slightly and it permits the ring to be slipped over the shaft of the bearing seat easily.

In removing a bearing, the same process may be duplicated, although overheating should be avoided. If the bearing remains tight pack the shaft in dry ice to make it shrink.

The conduit threading machine that gives you

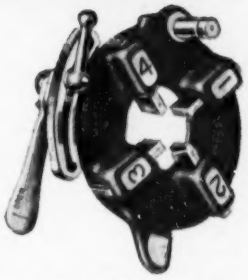
Top Performance

RIDGID "500"



...with exclusive new quick-opening

Quadritype Die Head



RIDGID engineering does it again! New "500" threads, cuts and reams with the efficiency and speed you've long wanted. Ready for work on any size conduit, ⅛" to 2", in seconds! Independent operation of tools, more than ample power, concealed oil system—a score of other great new features. No wonder its popularity has been immediate and wide-spread. See it, try it at your Supply House—buy the more-for-your-money RIDGID "500"!

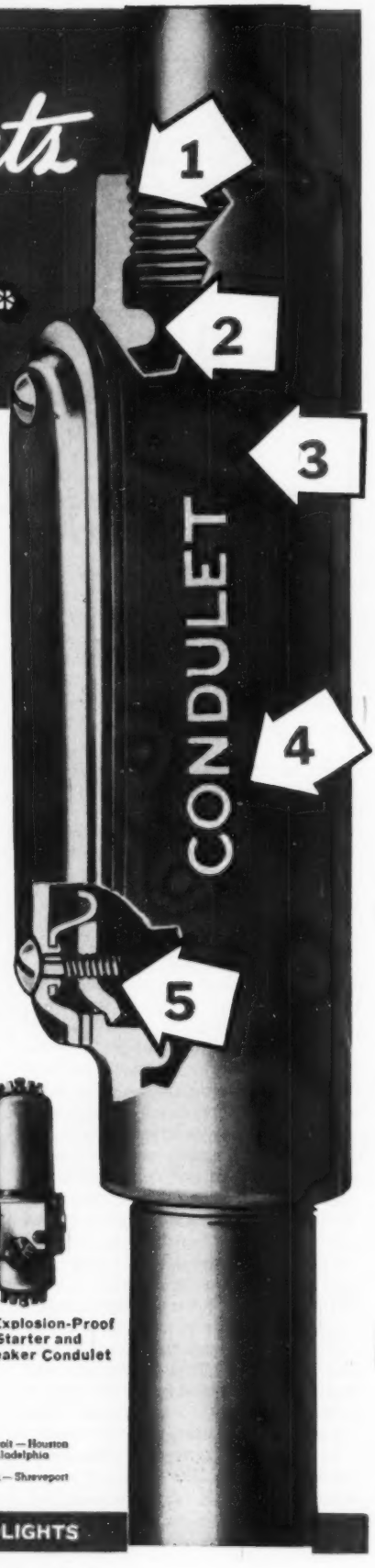
New Quadritype die head adjusts instantly 1" to 2" regardless of position of lever, without removing dies or head from machine. Same work-saver feature in Dualtype die heads—¼" and ⅜", ½" and ¾". Monotype also available, ⅛" to 2"—also bolt die heads, ¼" to 2".

THE RIDGE TOOL COMPANY • ELYRIA, OHIO

RIDGID

Work-Saver Pipe Tools

In electrical installations *where QUALITY counts* use CONDULETS*



Quality does count in practically every electrical conduit installation that you make. When you use CONDULETS you know that you are putting in electrical equipment of the highest quality, because CONDULETS have been doubly tested . . . in the factory and in the field.

Crouse-Hinds quality control assures a long-lasting product and field records prove it by the test that only time can give. Thousands of CONDULET installations are still in tip-top condition after twenty, thirty, or even more than forty years of dependable service.

The illustration at the right shows four of Crouse-Hinds' basic quality features that are common to all CONDULETS. The fifth, Wedge Nut Fasteners, is an exclusive Crouse-Hinds feature that has made Obround CONDULETS preferred by electricians everywhere.

Type EVA Explosion-Proof Lighting Fixture

Type ARE Arktite Receptacle Equipment

Type FS Condulet With Pilot Lamp Receptacle, Switch and Plug Receptacle

Type GUAC Explosion-Proof Junction Condulet

1. **Taper tapping.** Condulet threads are taper tapped to match tapered conduit threading. Makes a rigid joint that will not loosen. This assures permanent ground continuity . . . important for safety.
2. **Integral bushing.** A smooth rounded surface protects wire insulation.
3. **Material.** Feraloy . . . a special alloy that is strong and tough, resists corrosion, and gives sharp, full threads
4. **Finish.** A triple treatment provides long-lasting protection . . . exceeds Federal and U. L. specifications.
5. **Wedge Nut cover fastener.** Clear cover opening . . . no projections. No loose parts . . . Wedge Nuts and screws self-retained. No screw holes to align.

More than 15000 items are listed in the Condulet Catalog including a complete explosion-proof and dust-tight line for use in hazardous locations.

On your next job, use CONDULETS . . . they're made right to last longer.

**CONDULET is a coined word registered in the U. S. Patent Office. It designates a product made only by the Crouse-Hinds Company.*

Type VC Vaportight Industrial Lighting Fixture

Type FLB Explosion-Proof Circuit Breaker Condulet

Type EPC Explosion-Proof Motor Starter and Circuit Breaker Condulet

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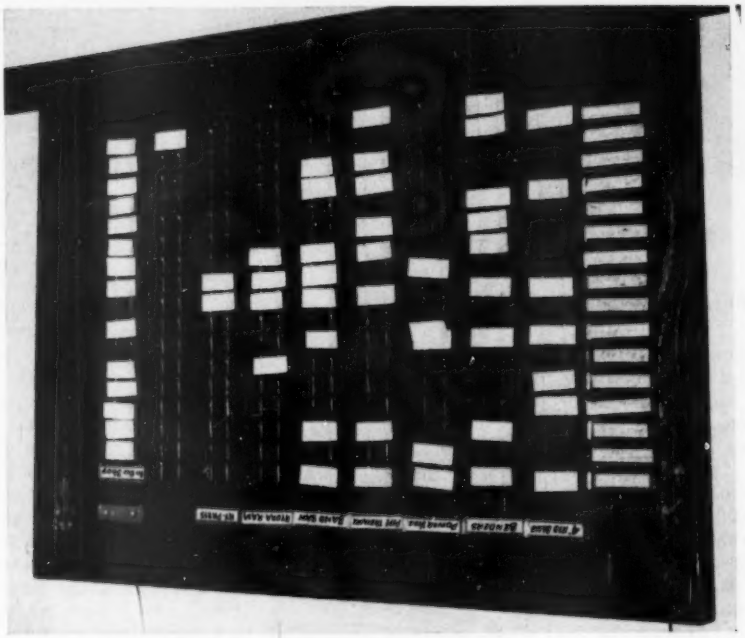
Practical Methods



TOOL CONTROL BOARD tells at a glance where power tools are distributed among active construction projects. Movable metal cord holders and wire card clips provide facilities for listing some 162 different tools under nine categories and 18 job designations. Cards carry individual tool number and code letter designating manual or electric operation.

Power Tool Control Board

OFFICE METHODS

The value of having an adequate number and variety of power tools on an electrical construction project cannot be over-emphasized. Neither can the importance of maintaining a simple. effective tool control system be taken lightly. The person responsible for job tool distribution at the home office should be able to tell quickly where all items are located without losing time consulting individual job files or shuffling through a sheaf of tool requisition sheets.

One system used by Electrical Contractors, Inc., Chicago, accomplishes this with a minimum of delay and confusion. It is a tool control board consisting of a rectangular piece of perforated fiber board on a wood frame. On it are listed all of the more expensive (cost of $100 or more) tool items in the shop or on the job. The board is equipped with movable metal card holders for project and tool categories; also a series of wire card clips for individual tool identification slips or cards. Both card holders and wire clips can be "plugged" in the perforations on the board.

The first vertical column on the board is a series of card holders identifying construction projects on the active list. Space is available for 18 job listings. The horizontal row at the top lists various power tool categories (space for nine listings). Categories noted in the accompanying photo are: 4-in. hydraulic benders, smaller benders, power vise, pipe threaders, band saws, hydraulic rams (pipe pushers), hydraulic cable connector tools. One vertical column at the extreme right is for tools in the shop.

Opposite the job identification card and under the proper tool category heading are small card or paper slips held by the wire clips. These cards carry individual tool identification numbers (numbers stamped on the tool) and a code letter designating electric or manual operation. Thus a card with M-602 under the 4-in. bender heading would mean that manually operated 4-in. hydraulic conduit bender No. 602 was on project XYZ. If the code letter were E, it would indicate that the bender was power-operated with an electric motor.

In all, there is space for listing approximately 162 different power tools under nine categories and opposite 18 different job names. When a question arises concerning the whereabouts of specific tool items, the person in the shop can get the answer by merely glancing at and studying the tool control board. And it is easy to shift tool cards around on the board to correspond with the shifting of tools from job to job.

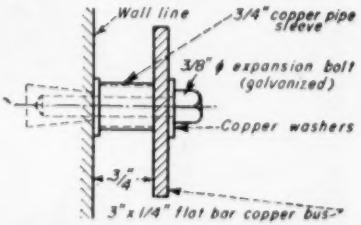
Grounding Bus Supported By Clamps

CONSTRUCTION

In the transformer vault of Pittsburgh's mammoth Gateway Center, a 3-million CM segmented ring bus is supported by ebony-asbestos blocks bolted to free-standing floor-to-ceiling galvanized channels, and four 2000-kva 12-kv/460-v transformers are connected to this ring through network protectors and stud moles. Transformer tanks are grounded to a flat bar copper bus which in turn is connected to copperweld grounding rods.

The method by which the copper grounding bus is supported around the vault takes advantage of the strength of galvanized steel bolts, yet the copper bus does not come in contact with the bolt and it is held away from the walls to permit the free circulation of air and prevent moisture accumulation.

This is accomplished by first drilling holes in the vault walls to receive expansion anchors for the bolts. Washers and copper pipe sleeves are then slipped over the bolts and, after the drilled busbar is roughly positioned, a second copper washer and a hex-head nut is placed over the bolt. As the hex-nut is tightened, the busbar, sleeve and washers are centered so that, when the nut is finally tightened to its desired stress, the bus is held by pressure between a copper-copper clamping arrangement.



COPPER WASHERS and sleeves hold the flat bus bar away from vault walls. Support of the bus depends upon pressure rather than direct bearing on the galvanized steel bolt anchored to the concrete.

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Insulating Foursome...

the correct selection to meet the many code requirements

DUTCH BRAND
Friction Tape

A friction tape with known and proven quality... for over forty years. Non-raveling... strong... 4 ply process... correct adhesion... no pin holes... high dielectric splices ... 2000 volts for a single thickness... long life. It costs no more to have this top quality tape . . . ask for DUTCH BRAND the next time you order.

DUTCH BRAND
Rubber Insulating Tape

DUTCH BRAND Rubber Insulating Tape fuses instantly without heat and has the high dielectric quality for good splices. It resists up to 18,000 volts through a single thickness. It contains no corrosive chemicals . . . it has long life and is dependable. DUTCH BRAND Rubber Insulating Tape serves a very definite unreplaceable service under electrical codes to meet many electrical insulating requirements.

DUTCH BRAND
PLASTIC TAPE

DUTCH BRAND Plastic Tape is made especially to meet electrical requirements. It is thin and flexible... with 150% stretch. It adheres to irregular shaped surfaces, is excellent for use where space is limited. It resists weather, oils, acids and corrosive chemicals. Dielectric resistance averages 1000 volts per mil of thickness. Available in .007" thickness or .010" thickness for heavy duty work — for use with power driven tape machines.

DUTCH BRAND
"DB" WIRE CONNECTORS

"DB" Wire Connectors are DUTCH BRAND top quality products... made to exacting specifications and design. Long skirt for full insulating protection... made of phenolic material, they are weatherproof ... vibration proof and resist pull-out, making perfect solderless connections. The knurled design makes them easy to handle and apply. They are available in four standard sizes, DB-1, DB-3, DB-4, DB-6.

Order from your electrical wholesaler

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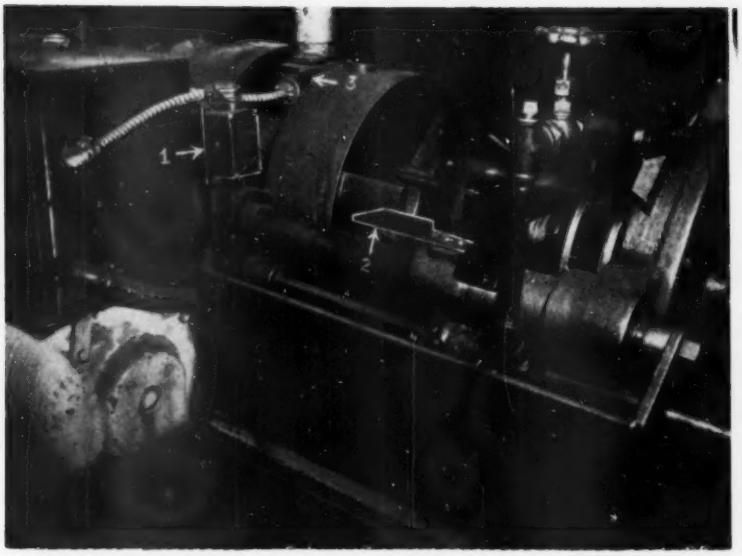
FRICTION TAPE... PLASTIC TAPE... RUBBER TAPE... WIRE CONNECTORS



LIMIT SWITCH SAFETY devices on pipe threading machine. Switch (1), when actuated by bar (2) on die-head slide, opens motor circuit and prevents jamming of die-head and rotating chuck jaws. Switch (3) in pipe collar is actuated by weight of chuck key wrench and closes motor circuit only when key is in collar.

Jam-Proof Idea for Threading Machines

TOOL SAFETY

There is always the possibility that a pipe threading machine will jam if the operator is not too attentive or permits the die-head to get too close to the revolving chuck. Once this happens it means costly repairs to the machine and—more important—loss of that piece of equipment for productive work on the job while repairs are being made.

Situations like this are rare on projects where the electrical installation is being made by Emerson-Comstock Co., Inc., Chicago electrical construction firm. The reason: pipe threading machines are equipped with limit switch devices to prevent such accidents.

Normally, two limit switches are installed on each machine. The first is primarily for personnel safety. It is mounted inside a pipe collar in which the chuck key wrench rests. When the key is being used to tighten the chuck jaws, the switch is in open position. When the key is placed in the collar "rest", its weight depresses the limit switch arm and closes the circuit to the threader motor. The threader will not operate unless the key is in the limit switch collar.

A second limit switch, mounted on a bracket near the revolving chuck, is actuated by a bar on the die-head slide. When the die-head comes within a predetermined distance of the rotating chuck jaws, the bar moves the limit switch arm and opens the motor circuit. This prevents jamming between chuck and die-head. Both limit switches are in series with the motor starting switch.

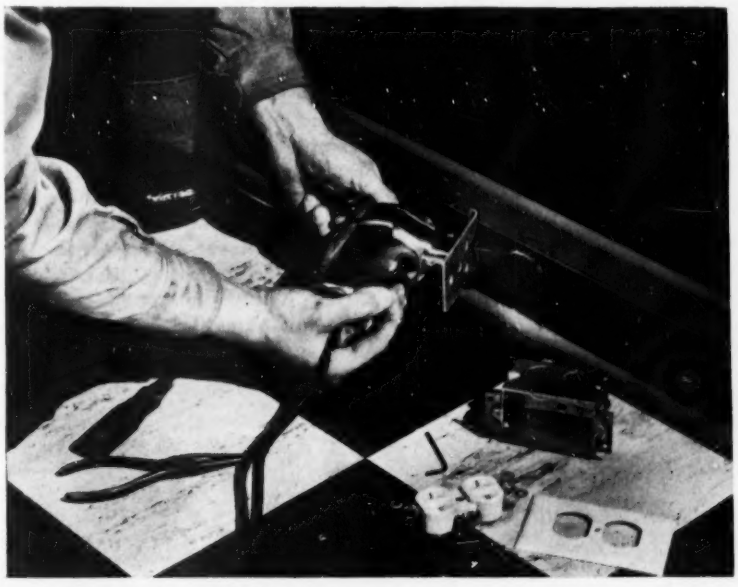
Emerson-Comstock finds that the small investment in parts and labor to equip pipe threaders with these safety devices has been repaid many fold through reduced equipment maintenance and elimination of the personal injury hazard.

Visual File Boards Roll On Overhead Tracks

INVENTORY

When any company, accustomed to discussing items of equipment in the technical terms of their trade, has to interpret what is in the mind of a non-technical customer placing an order, mistakes frequently result because there is not a clear "meeting of the minds". For example, it is easy for a non-technical person to refer to a toggle bolt as a wing nut, or request a floor plug when they mean an outlet box. In fact, when other than correct names are used for parts or equipment, a supplier could easily furnish the wrong item or else state that the item is not carried in stock.

This possibility of error is precluded at Tinnerman Product's modern manufacturing plant in Cleveland, Ohio, however, for there they use a series of rolling filing racks where a sample of each Tinnerman product is displayed on a series of closely-spaced hooks. Each product is tagged and cross-indexed with their master file so that, if any doubt exists as to the exact product in mind, they can show the sample to a customer and ask, "Is this what you have in mind?" Also, when a duplicate order is received from a customer to duplicate an item formerly ordered, it is an easy matter to check the previous order number, refer to the rolling file boards, and give the sample to the pattern maker for reproduction.



PORTABLE ELECTRIC JIG SAW makes quick work of cutting openings in baseboards and walls for electrical outlet boxes. Piercing action of saw blade works easily into the wood to start outline cut; eliminates former methods of drilling numerous holes for keyhole saw, while edges of hole are sharp and neat.

Piasecki Helicopter Corporation, makers of two of Uncle Sam's most important helicopters—the 14-passenger Air Force Work Horse, and the 6-seat Navy HUP—has installed Marcus dry type Transformers to do the vital power job in their big new plant at Morton, Pa.

They were selected because every detail of the Marcus dry type transformer is engineered for long life... and continuous, trouble-free performance. Latest contribution pioneered by Marcus for greater transformer durability is Hi-Heat, Hi-Dielectric Magnet Wire, insulated with DuPont's newest miracle polyester film *"Mylar,"* combined with Johns-Manville *"Quinterra"* to reach insulation levels at least 10 times present industry standards.

Capacities from 1 to 3000 KVA

- DISTRIBUTION
- GENERAL PURPOSE
- UNIT SUBSTATION
- PHASE CHANGING
- ELECTRIC FURNACE
- RECTIFIER
- WELDING
- MOTOR STARTING
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"Mark of Quality"

MARCUS
TRANSFORMER CO., INC.
HILLSIDE 5, NEW JERSEY

Representatives in Principal Cities

ONE OF THE WORLD'S LARGEST MANUFACTURERS OF DRY TYPE TRANSFORMERS EXCLUSIVELY

CLOSELY SPACED HOOKS on plywood panels hold vast number of parts, or samples of work turned out by a manufacturing company. Tags, cross-indexed to office files, make it possible to quickly locate exact item to be reproduced. This visual inventory also eliminates guesswork on the part of a non-technical customer when he is ordering material.

These file boards are made of plywood sheets, are mounted close together, can be moved freely along overhead tracks and can be pushed out of the way when not in use.

This idea can advantageously be used by any electrical shop having direct contact with the public, for frequently a layman can point to an item that he can't name, thereby eliminating all possibility of error.

Mobile Working Platform Operates By Air And Dry Battery

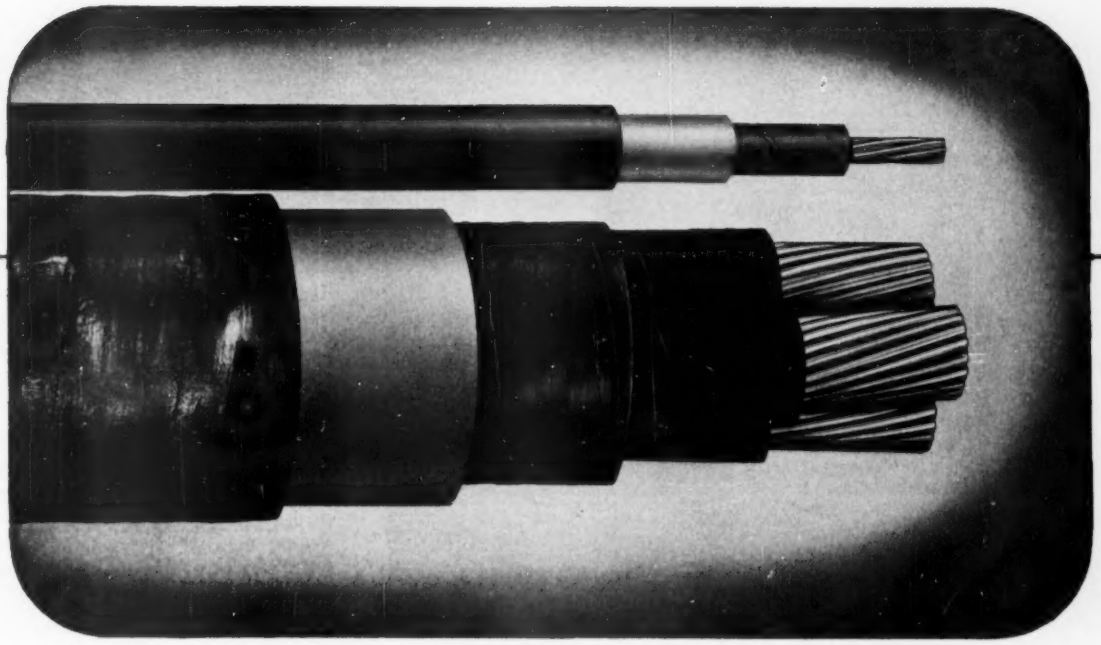
MAINTENANCE

Welding, installation of equipment or maintenance work in high places is greatly facilitated for the Elmco Construction Company of San Francisco through the use of a compressed air and hydraulic high-lift working platform developed by Ormand Hukari. While working on an installation for the Tuxedo Candy Plant in San Jose, for example, this device eleminated the use of ladders and scaffolds, provided a sure-footed working platform at all required elevations, was easy to move about to various locations and provided an easy means for workmen to reach their various levels of work.

Counterbalancing is such that it is easy to raise or lower the boom manually, although normally the platform is raised automatically when a brake is released and air pressure is thereby admitted into the control chamber. No recharging of this compressed air chamber is required, and operation is

ROEBLING PROTECTIVE COVERINGS ON LEAD SHEATHED CABLE

for utilities, chemical plants and the petroleum industry



LEAD SHEATHED CABLES used in certain applications by public and private utilities, chemical plants and the petroleum industry are often impaired by electrolysis or chemical corrosion. But such corrosive action can be effectively reduced, and cable life extended, by using Roebling Paper Insulated and Varnished Cambric Cables with either of two outer protective coverings.

One of these coverings is an extruded thermoplastic sheath employing a special high-molecular weight polysthylene. The other is ROESHEATH, built up of neoprene and neoprene-filled fabric tapes and vulcanized directly over the lead sheath. Both coverings not only provide essential protection, but, in some cases, may permit the thickness of the lead sheath to be reduced.

For longer, more dependable cable life and worthwhile economy write for full information... and get our recommendations for solving any special problem.

John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

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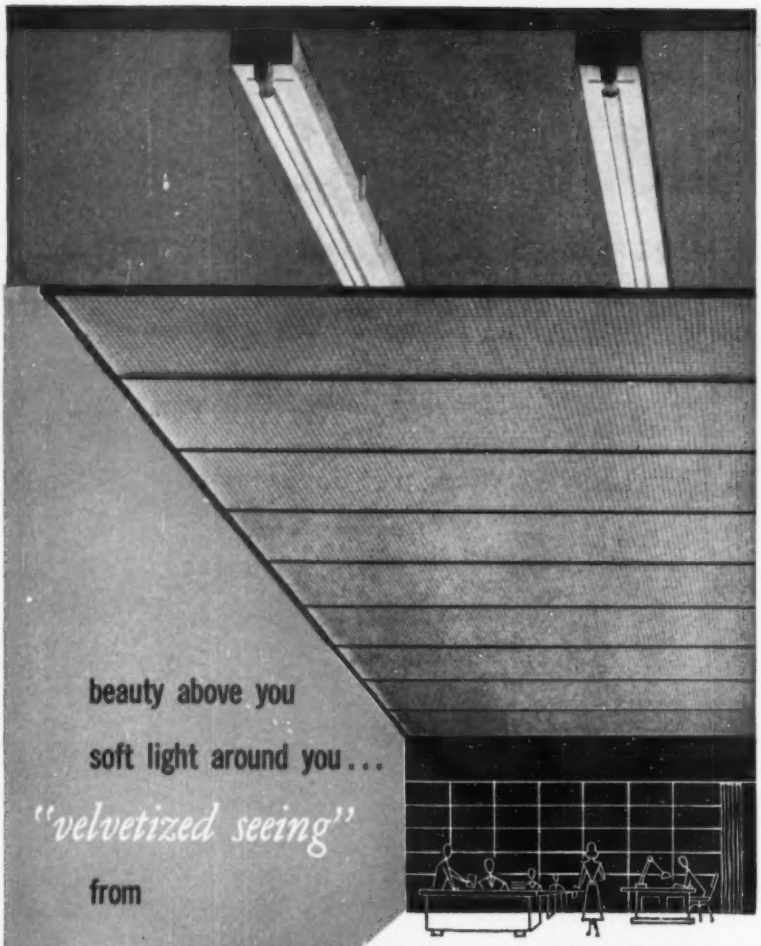

beauty above you

soft light around you...

"velvetized seeing"

from

GUTH GRATELITE* CEILINGS

covered from wall to wall with GrateLite, the diffusing plastic louver ... an architectural dream.

Diffusion through 3/8" translucent cubical facets produces finer quality illumination ... fills the room with soft light for "VELVETIZED SEEING". It keeps your eyes "at rest" and makes your work easier.

simple installation: Just 5 parts to handle.

easy maintenance: Relamp by removing only 1 panel. Panels can be detached and washed in 2 minutes ... just shake in detergent water.

Start a new era of eye comfort—with up to 200 foot-candles! Write today on your letterhead for folder 905-A and GrateLite layout guide.

Guth

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*U. S. & Can. Pats. Pend.
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WORKING PLATFORMS having either 11 or 15-foot lifts are useful in both installation and maintenance work. Counterbalancing makes it possible for the platform to be raised with modest quantity of compressed air, and lowered again by means of power supplied by 6-volt battery.

by means of a 6-volt battery which is satisfactory for a thousand or more lifts without rechanging or recharging the power unit.

Two models are available for this type of work; an 11-foot and a 15-foot lift being possible.

Photoelectric Beam Operates Fire Door

CONSTRUCTION

An electronic beam acts as a robot doorman in the modern Synthane plant at Oaks, Pennsylvania, where elaborate safety precautions are taken

FLOOR-RECESSED LIGHT BEAM is directed to overhead photocell mechanism which opens fire door on approach of materials-handling dolly and automatically closes the portal when the material being processed has passed from one department to another.

to protect employees and property in those departments devoted to the manufacture of thermosetting laminated plastics. This installation results in both safety and efficiency, since twin "electric eyes" automatically open all fire doors which would otherwise impede the normal traffic flow between production and shipping departments.

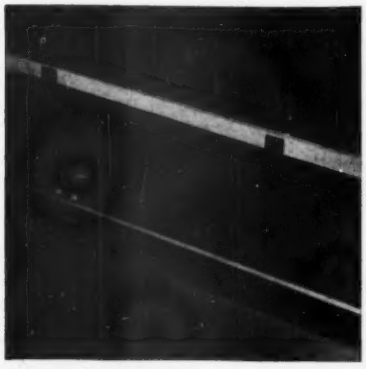
Interruption of one beam actuates the electronic circuit which opens the door, while interruption of a second beam closes the portal after material has passed through the opening.

The floor-recessed beam of light in each instance is directed to an actuating photocell positioned 15 feet above, and the device is so timed that the door is operated in a matter of seconds. This prevents the door from being opened inadvertently, requires no manual effort on the part of the employee moving the material by dolly or truck, and promotes both safety and operational speed.

Test Benches Have Grounded Power Outlets

PRODUCTION

Test benches installed for Daystrom, Inc., on the outskirts of Scranton, Pennsylvania, are equipped to supply power to the workers through plug-in outlets spaced along the leading edges of the tables. These outlets are mounted directly to metal wireways that are secured to the bench edges, and connections between these wiring strips and branch circuit conduits are effected through standard transfer sections. Power outlets are of the three-prong type, thereby providing facilities for the positive grounding of all hand tools used by the workers as indicated, the wiring channels are located in a most convenient position and then streamlined construction offers no obstructions or means for snagging clothing.



METAL WIREWAY is secured to leading edge of all work or test benches, with three-prong outlets providing means for grounding all hand tools.

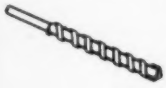
DON'T waste valuable time struggling with old-fashioned hand tools when you have a hole to drill! Switch to Black & Decker power and see how much time (and money) you actually save on every job!

Take the B&D ½" Standard Drill, for example. You just can't beat it for general-purpose use on all your jobs! It drives twist drills, Hole-Saws and wood augers for drilling joists and steel boxes; installing switch boxes, cut-outs and switch boards; cutting through switch and terminal boxes in BX work; deep boring in heavy timber and planking. With carbide-tipped drills, it goes through brick, cement and cinder block walls. And a special right angle attachment makes drilling in tight places a cinch.

See your nearby Black & Decker Distributor for a demonstration. Write for a FREE, detailed catalog to: THE BLACK & DECKER MFG. Co., 617 Pennsylvania Ave., Towson 4, Md.

B&D Right Angle Attachment is perfect for close-quarter work, like reaching out-of-the-way places on joists. **Transmits** full power; maintains correct spindle speed. Attaches to B&D ½" Standard and larger drills.

B&D Hole-Saws cut clean, round holes *faster*—in wood, steel, plastics, board, alloys. Perfect for cutting through switch and terminal boxes. Fine-tooth and coarse-tooth styles in sizes from ⅝" to 4" diam.; mandrels to fit all electric drills.



B&D Masonry (Carbide-Tipped) Bits go through brick, cement, cinder block and similar materials much faster than a star drill, and the hole size is maintained more accurately. Easily sharpened without reducing cutting diameter.

Get more details about Portable Electric Saws, Hammers and other Black & Decker Tools from McGraw-Hill's Electrical Catalog.

B/D Black & Decker
PORTABLE ELECTRIC TOOLS

G.E. Announces New Rigid Conduit

A new G-E WHITE rigid steel conduit that has easy bending, easy wire-pulling, and improved corrosion-resistance characteristics has been introduced by General Electric's Construction Materials Division.

These improvements have been made possible by a zinc-coating process called "metallizing", which has been proved by more than 30 years of service in other applications. Metallizing bonds a controlled, uniform coating of pure zinc to the conduit, threads and all, to provide lasting protection against corrosion. The conduit is then given the added protection of a coating of C-553 lacquer over the metallized zinc.

New G-E WHITE rigid conduit conforms with the American Standards Association specifications, is listed by Underwriters' Laboratories, Inc., and meets all U. S. Government specifications. Ask your distributor about it. Section **C25-918**, Construction Materials Division, General Electric Company, Bridgeport 2, Conn.

New G-E WHITE is easier to bend because the "metallizing" process flame-coats the zinc to the conduit—eliminating the quenching and straightening that cause hardening.

Wire-pulling is easier because new G-E WHITE is lined with a new corrosion-resistant coating, containing an anti-friction agent.

You can put your confidence in—

GENERAL ELECTRIC

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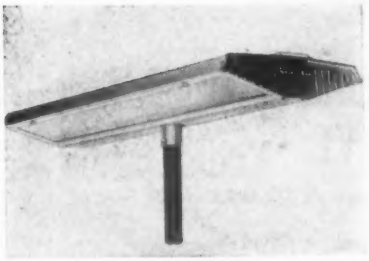
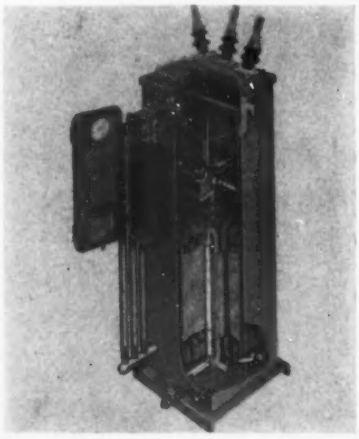
Product News



Fluorescent Fixture (1)

A new horizontal fluorescent fixture designed for low cost change-over to wide range, high-intensity pump island lighting. Known as Model 470, the new "T" light is engineered to furnish greater illumination on both sides of the island through a light source 15° from horizontal. Fixture is equipped with instant start ballasts and six instant start lamps. Over-all dimensions: 49½-in. long, 24-in. wide and 6-in. high. Fixture has built-in leveling device, and five ½-in. knockouts in top for spot or floor lampholder mounting. Latching arrangement permits opening of glass frames for cleaning or relamping. Unit can be mounted on poles, standards or bracket arms, or suspended under canopies.

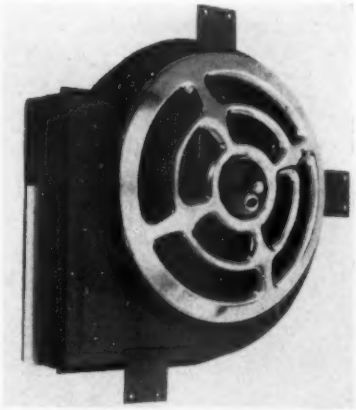
Guardian Light Co., 301 Lake St., Oak Park, Ill.



Regulator (2)

Type SU induction voltage regulator has been redesigned. Mechanical adjustments have been eliminated from the control, and type SJ voltage regulating relay is used in the new all electrical control. All relays are now mounted on the back of a swinging panel to facilitate periodic inspection. A hand wheel at upper end of vertical motor shaft allows easy hand operation. A vertical terminal board has connections for either series or parallel operation of the secondary winding. Suitable links make possible convenient connection changes.

Westinghouse Electric Corp., Pittsburgh 30, Pa.



Ventilating Fan (3)

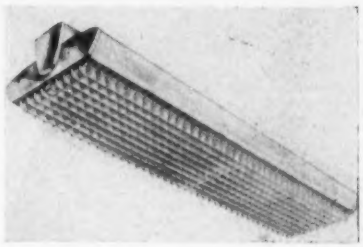
A new Marco V8 ventilating fan moves volumes of air by a scientifically designed blade propelled by a floating-power motor, engineered for quiet operation. V8 blade is of special aluminum alloy. All parts are accessible for fast installation. Loosen one screw and the J-box cover slides out, leaving the J-box open for wiring. After plastering, the pre-wired motor plugs into a handy receptacle. Complete fan unit is 3¼ inches thick. Motor specifications: 110 volts, 60/50 cycle, 100 watts. Discharge rating: 350 CFM; free air, 800 CFM.

Marvin Manufacturing Co., 3071 East 12th St., Los Angeles 23, Calif.

Silver Plating Solution (4)

A new industrial silver plating solution, known as Nu-Silver No. 66, makes it possible to silver plate without electricity. It can be applied with a soft cloth or brush or by immersing. Can be applied in underground locations or on poles. Solution can be used on silver, copper, brass, bronze, German silver and many other metals and alloys.

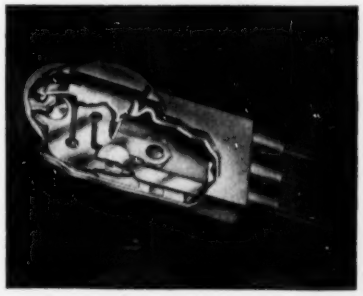
Specialty Manufacturers and Distributors, 508 New York St., Aurora, Ill.



Fluorescent Lighting Unit (5)

A new fluorescent lighting unit, called the Pioneer, is especially designed for use in schools, offices and retail stores. Made of steel and plastic, it eliminates contrasts by transmitting a soft overhead light and glare-free down-lighting. A feature is the adaptable socket holder bridge. It is possible to change the number of lamps or lamp spacing in the field for intensity, to meet existing requirements, without removing the fixture. It can be mounted individually or in continuous rows. Ballast and wiring are easily accessible for servicing and louver may be opened from either side for re-lamping.

Smithcraft Lighting Division, Chelsea, Mass.



Switch (6)

A new three wire type basic snap-action waterproof switch. It is single pole, double throw, featuring sine curve design and miniature size. Basic switch mechanism is enclosed in a waterproof material and will operate without damage in temperatures ranging from minus 65°F to plus 165°F. Electrical capacity is 20 amps resistive, 28 volts dc, 10 amps resistive, 110 volts ac. Switches are recommended for use wherever water, oil, grease, dust, grit, dirt or other harmful factors are present. They are also available in two wire types.

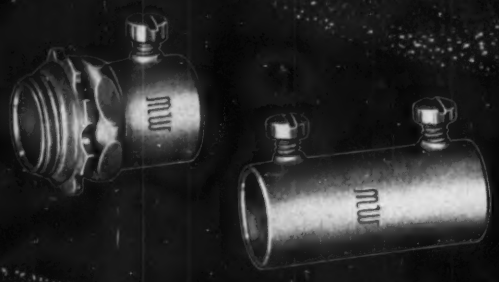
Control Products, Inc., Sussex Street, Harrison, N. J.

ANOTHER

midwest

EXCLUSIVE

"Crimped Set Screw" fittings for thin wall conduit



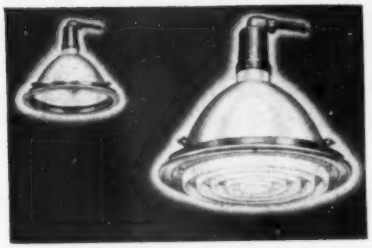
Set screw cannot fall out because it is "locked in"

Midwest Electric Mfg. Company

MANUFACTURERS OF ELECTRICAL WIRING PRODUCTS

1439 W. WALNUT STREET

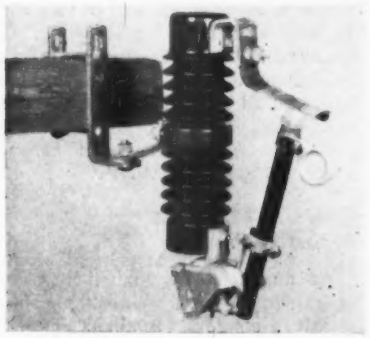
Chicago 12, Illinois



Lighting Fixtures (7)

Round incandescent recess lighting fixtures called Loov-O-Lites. They are built with Alzak aluminum reflectors, and are for general or accent lighting. Two types of reflectors are available: a narrow 30° beam design and a wide-angle 70° beam. Both are made in three sizes to handle lamps from 60 to 300 watts. Three bottom assemblies are available: open, concentric metal louvers with 35° cutoff, and glass louver lenses which diffuse downlight. To simplify wiring and installation, they are designed so socket-covers are detachable from reflector. Listed by Underwriters Laboratories, Inc.

Edwin F. Guth Company, 2615 Washington Ave., St. Louis 3, Mo.



Dropout Fuse and Cutouts (8)

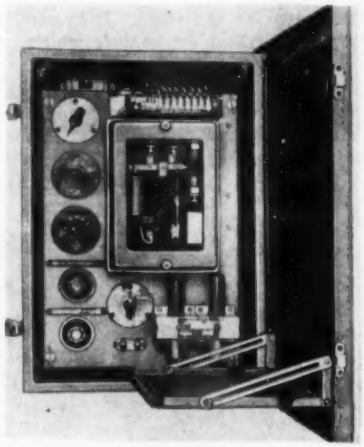
A new and improved line of open-dropout fuse and load-break cutouts. Features include a hollow-tube, wet-process, porcelain insulator with mounting support clamped to porcelain by a "U" bolt insulated with rigid polyvinyl chloride insulation, and a shielded top contact and latch for protection from dirt or sleet. Top and bottom fittings are compression-bolted to porcelain. Line includes ratings of 7.8 kv and 15 kv, 100 amperes. Three interchangeable fuseholders provide a NEMA standard 2000-ampere interrupting rating, heavy-duty 5000-ampere interrupting ratings, and a load-break up to 100 amperes, any power factor.

General Electric Co., Schenectady 5, N. Y.

Varnishes (9)

A new series of Class H silicone electrical insulation varnishes have been designed for applications ranging from flexible glass cloth or tape to rigid tubular transformer insulation. They are used to provide Class H insulation for such electrical parts as coils, armatures, and stators, and also for use as binders on mica-glass combinations and coatings for glass tape and asbestos paper. Silicone coating varnish R-61 is intended for glass cloth and tape applications; Silicone Impregnating varnish R-62 is used in coating of electric coils, armatures, and stators intended for heavy-duty service; and thermo-setting silicone resin R-63 is used as a bonding and protective coating for numerous applications.

Linde Air Products Co., a Division of Union Carbide and Carbon Corp., 30 East 42nd St., New York 17, N. Y.



Voltage Regulators (10)

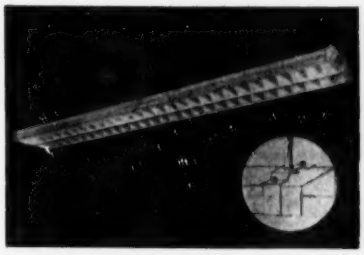
New Type PRS pole type step voltage regulators, single phase, 60 cycles. Voltage regulation of plus or minus 10% is provided in 32 equal steps of $\frac{5}{8}$% of the rated voltage. They are self-contained and automatic in operation. They are especially suitable for branch and rural distribution lines. Regulation is performed by a series of tapped windings, a drive mechanism and switching mechanism. The heart of the regulator is the motor driven selector switch. Switches or terminals of tapped winding are arranged in a circle and are mounted in parallel on two identical mounting panels. Selector switch determines the magnitude to which tapped winding will buck or boost output voltage. Reversing switch determines polarity of tapped winding.

Moloney Electric Co., St. Louis 20, Mo.

Tool (11)

A new "Plus-Power" Jobmaster powder-actuated fastening tool which does medium-duty fastening into steel and concrete. It has a barrel diameter of three-eighths of an inch. The larger-diameter barrel is being produced as a separate lower assembly so that many Jobmaster tools already in use in the field may be fitted with new barrel assembly. Thereafter, the tool uses the regular or "Plus-Power" barrel assembly interchangeably, depending on requirements of any particular job. Teamed with the "Plus-Power" are special Tru-Set flat head drive pins and adjustable utility head threaded studs. It weighs 6-$\frac{3}{4}$ lbs.

Ramset Fasteners Division of Olin Industries, Inc., 12117 Berea Rd., Cleveland 11, Ohio.



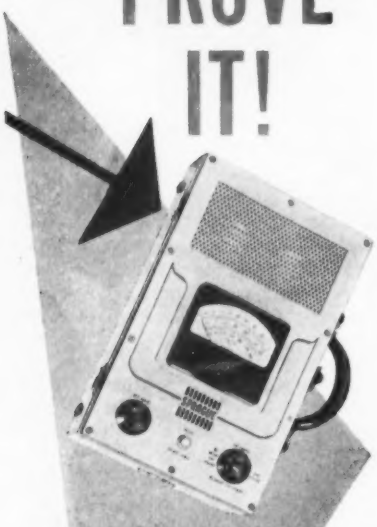
Fluorescent Fixtures (12)

A new line of "20/20" fluorescent fixtures. They are available in five models and desirable for school room use as well as for commercial installations. All models are available with metal or Styrene side panels and feature "Liquid Plastic" baked enamel louver fins which have been redesigned to achieve even partitioning of light throughout length of fixture. Fins are available for providing 35-25, 35-45 or 45-45 degree shielding and are interchangeable in one channel. Louver panel hinges from either side. Series incorporates 2 and 4 light 4 ft. units, as well as 4 ft. and 8 ft. slimline and 8 ft. hi-pin fixtures.

Electro Silv-A-King Corp., 2000 W. Fulton St., Chicago, Ill.

Customer Wiring Overloaded?

PROVE IT!



...with the Sprague

ADEQUATE WIRING ANALYZER

This compact Sprague instrument easily and quickly checks wiring to see if it's adequate for present or contemplated loads.

Prove to customers the effect of increasing loads on their wiring *right in their own home.* Direct reading meter indicates percentage voltage drop on 115 or 230 volt circuits under load *without troublesome calculations.*

Connectors for convenience outlets, appliances, panel boards, etc., are furnished—ideal for use in home, farm, or plant.

Write for Bulletin PF-600—
Sprague Electric Company,
333 Marshall Street,
North Adams, Massachusetts

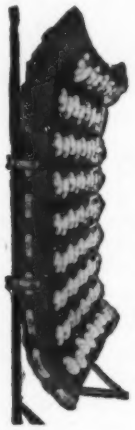
SPRAGUE

PIONEERS IN ELECTRIC AND ELECTRONIC DEVELOPMENT

Rectifer (13)

New My-T-Midget rectifier is a small, self-contained unit which provides dc from an ac source. The "box" which plugs into an ac outlet eliminates the necessity for discarding small dc operated machinery when power source is changed from dc to ac. It is a practical dc source for magnetic chuck and applications. It employs selenium cells for its converting action. Plug the rectifier into the ac source, flip the toggle switch on face of panel, and a red pilot light instantly indicates that dc is available. A standard fuse is mounted on the front. It is supplied in a crackle-finish cabinet which can be mounted next to machine or on wall. It has an "on" and "off" toggle switch and a U/L approved industrial-type heavy duty cord and plug. Its ac input is single phase 110 volts or 220 volts. It is available in a variety of sizes from 1. amp to 8.5 amp.

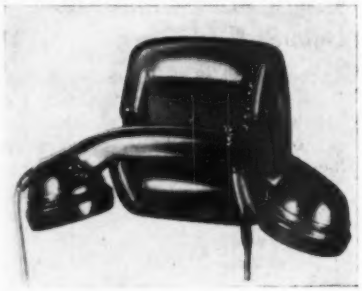
American Rectifier Corp., 95 Lafayette St., New York 13, N. Y.



Infra-red Oven (14)

A new line of large size infra-red ovens, for large area side heating applications. Units are available in 32- and 48-inch long standard sections, and the Patent-Flex design permits tight multiple section joints, with each section individually adjustable from the outside. Each lamp row has two complete panels of asbestos insulated, metal backed construction. Oven is designed for taking care of larger installations, and is equally well suited for both conveyorized and non-conveyorized batch oven work. Oven is installed so that the contour of oven can be changed while it is in actual operation. Ovens are designed for use with R-40 reflector lamp.

Wil-Son Mfg. Co., Cloverport, Ky.



Phone System (15)

The DUO phone system operates on dry cell batteries. It is supplied in sets of two, adaptable for either wall mounting or desk use. Distances up to 900 feet are covered by the system. Phone operates on a small flashlight type battery capable of powering the phone for 6 to 12 months. A built-in buzzer notifies the other party that he is wanted on the phone. In office installations buzzer may also be used separately for signaling. It is recommended for use in small offices, workshop to store, home to garage, basement to kitchen, service entrance to kitchen, small factories, farms, etc.

Paul C. Roche Co., Inc., 11 Park Place, New York 7, N. Y.

Industrial Alarm (16)

An annunciator system that warns of its own failure as well as that of the circuit it monitors. Available in three standard units—plug-in, cabinet and lamp box. Cabinets are available in five standard sizes, 1-3-5-7-11 units wide. They may be stacked on top of each other or side by side to provide infinite variety for any annunciator system. Standard cabinet includes relay plug-in units, but also available for remote mounting. The plug-in signals its own failure as well as the system defects and can be used with both normally open or normally closed field signals. They are interchangeable on the job. Light box comprise two standard basic types, bullseye and back lighted name plate. In addition, each type may be supplied with an integral toggle switch for a ring back sequence and also, each type may be supplied with individual reset pushbuttons.

Scam Instrument Corporation, 3909 West Irving Park, Chicago 18, Ill.

ELECTRICAL CONTRACTORS

Again Sylvania extends a helping hand

This Qualified Lighting Contractor emblem helped many electrical contractors make amazing gains last year. Don't miss this latest and greatest opportunity NOW!

QUALIFIED
LIGHTING
CONTRACTOR
AUTHORIZED
SYLVANIA
SALES SERVICE

Once again, Sylvania offers Electrical Contractors a sure-fire, *proved* program for stepping up business this Spring and Summer.

The Program is in 3 Parts

Part 1 builds national recognition for the electrical contractor's services through full-page national ads that carry the lighting contractor's emblem in *Time, Business Week, Newsweek,* and other important magazines. Also sparkling, live commercials on the great TV show "Beat the Clock" will display the emblem to millions everywhere.

Part 2 is a carefully designed publicity campaign to build up your importance as the Qualified Lighting Contractor in your community. You get professionally written talks of interest to clubs and civic organizations. Also free radio and TV scripts, news releases, decals for your windows and trucks. Also ad mats for newspapers and telephone directories . . . all planned to throw a new light on the scope and importance of your services.

Part 3 consists of a complete personalized direct mail campaign to bring business right to your door. Every mailing piece has a walloping appeal, and every one is different! All mailers will be imprinted with your name and address, and accompanied by a hard-selling letter printed on your letterhead . . . and *mailed by Sylvania to every prospect on your list!*

The cost? Only 8¢ per name (100 names minimum). This includes postage and all handling charges. So why delay? Fill in the coupon and mail it NOW!

SYLVANIA

LIGHTING • RADIO • ELECTRONICS • TELEVISION

In Canada: Sylvania Electric (Canada) Ltd.
University Tower Building, St. Catherine Street, Montreal, P. Q.

Sylvania Electric Products Inc.
Dept 3L-2109, 1740 B'way, N. Y. 19, N. Y.

Please send me complete details about Sylvania's 1953 Promotion for Qualified Lighting Contractors.

Name_____

Company_____

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Whatever the reason—when a good price clerk leaves you, trouble looms ahead. But leave or stay, an answer lies in NATIONAL PRICE SERVICE for then practically anyone can successfully price out your jobs.

Think what it will mean to you to have

NATIONAL PRICE SERVICE

right at hand, ready to work day or night, for then you have completely up-to-the-minute net figured material costs, manufacturers' comparative catalog numbers, standard packing quantities, concise descriptions; in fact, every bit of vital information, including suggested selling prices and with every listed item illustrated. That, Mr. Electrical Contractor, makes it easy for you (or anyone in your organization) to bill out your jobs. Estimating is simplified with extreme accuracy assured. Costing, checking invoices, any price work dealing with materials becomes not a nightmare but a routine operation.

Better get the full story today. Your inquiry will obligate you in no way and you owe it to yourself to know all about

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NATIONAL PRICE SERVICE is available to recognized electrical contractors. Its fee is very nominal. If you are an electrical contractor, you are invited to write us on your letterhead for a full description with no obligation whatsoever. Make NATIONAL PRICE SERVICE your key to more profitable, less burdensome pricing.

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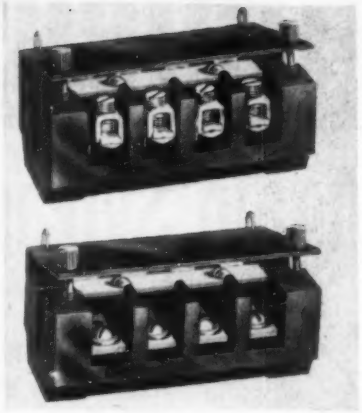


Terminal Blocks **(17)**

Heavy-duty molded terminal blocks are available with non-separable hinged covers. Blocks can be furnished with either screw or solderless type contacts, and in 4, 6, 8 or 12 circuit sizes with either plain or numbered marking strips. They are rated at 750 volts, 35-amperes for screw type and at 750 volts, 50 amperes for solderless type. Blocks are molded of CFG compound but can be furnished in special materials and finishes, or with special circuiting arrangements, marking details, etc.

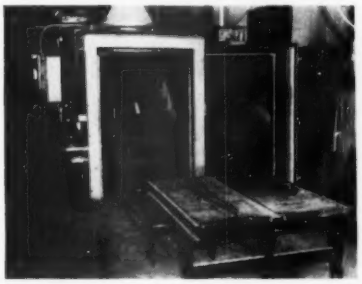
Buchanan Electrical Products Corp., 225 Route 29, Hillside, N. J.

Insulator **(18)**

A new line of clamp-top line post insulators for high voltage use. Available in eight voltage ratings from 20 kv to 88 kv with four completely interchangeable clamp sizes in ferrous or aluminum for conductor diameters from .25 inches to 1.50 inches. It is a single porcelain, fog-type post design. Clamp-top is externally bonded to porcelain to prevent

destructive cracking forces. Cap screw forms one end of trunnion bearing for convenience in insulator change and is backed off, not removed, and conductor, with clamp still attached, lifted out of position.

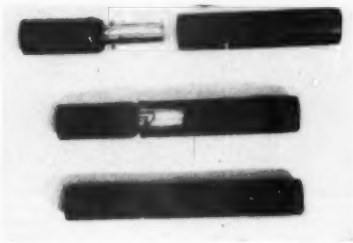
Lapp Insulator Co., Inc., LeRoy, N. Y.



Ovens **(19)**

New insulation roasting ovens for use in electric motor repair. Oven's air cooling system provides complete incineration of varnish and other combustible material on motors, distribution transformers, dipping racks, and hooks. Oven automatically shuts off fuel at incinerating temperature, permitting combustibles to carry process to completion. Slight modifications of basic oven can be made to include features for preheating large babitted bearings and melting out old bearings. Available in two sizes.

Michigan Oven Company, 415 Brainard, Detroit 1, Mich.



Cable Connector **(20)**

The "Dalweld" detachable welding cable connector is designed for heavy duty. Connectors have an expander-type male end which makes a large area contact. When this is inserted into female end with a quarter turn it makes a wipe-joint fit for complete electrical contact. Current-carrying parts are made from bar brass, machined to close tolerances. Casing is a heavy duty insulating fibre tube. Connectors are made for both solder and mechanical connections, in 400- and 600-ampere capacities.

Dalweld Company, 1 Bertel Avenue, Mt. Vernon, N. Y.

The Features You Asked for:

the NEW Super Safe IDEAL Voltage Tester

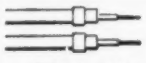
Thousands of Electrical Men Told Us What They Wanted — We Included Every Major Feature — No Other Tester Offers So Many Advantages for Easier, Safer Use:

NO OTHER TESTER HAS ALL THESE:

Handier center mount for prod makes testing easier

Prod storage completely shields sharp tips

Coil layer-wound on rugged nylon spool for long, safe life



Molded rubber, moisture-tight prod handles— "No-Slip" safety rings; 30" neoprene leads

Double strength, seamless plastic case

Plastic name plate bonded to case— **no surface metal**

Coil secured at both ends —Coil leads isolated, preventing shorts

"Fog-Free" window keeps out dirt

PLUS **Famous IDEAL "DOUBLE PROTECTION"**

. . . a solenoid, calibrated indicator AND a neon test lamp, each independent of the other — NO CHANCE OF FAILURE TO DETECT VOLTAGE.

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1041 Park Avenue, Sycamore, Illinois

Please send me full catalog information on new IDEAL Voltage Tester

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Company_____

Address_____

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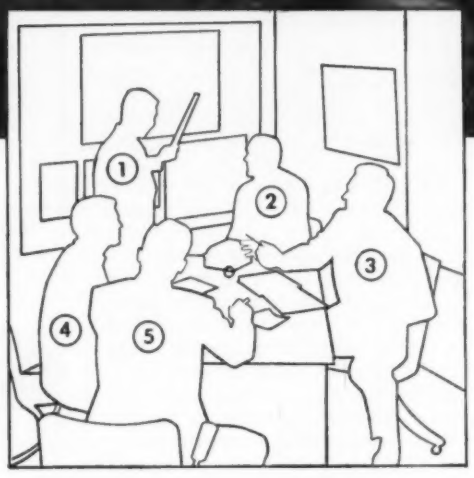

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4. Electrical Engineer
5. Production Superintendent

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Your local Westinghouse sales engineer has a broad knowledge of all Westinghouse Motors and Controls. He knows their capabilities and limitations. He knows how to match motors and controls for maximum production.

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Then ask for Titchener Rex Cable Staples. All types and sizes. In bulk, or packed in handy boxes. There's a distributor carrying Rex Staples near you.

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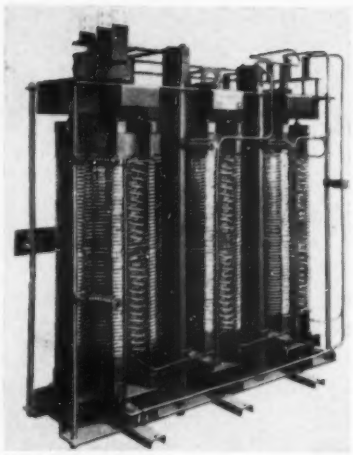
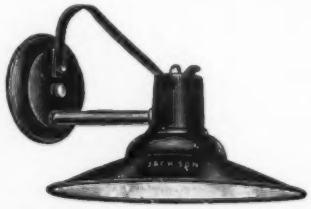
Mfrs. of Staples and Wire Parts for 65 Years



Transformers (21)

Dry type transformers for high voltage unit sub-stations. This 1000 kva, 4160 delta-480 delta transformer is designed to meet or exceed NEMA, ASA, and JIC standards. Units have adequate core and coil blocking, high voltage insulators, and well ventilated pancake type coils. Core is designed to operate as a moderate flux density. Available either as a core and coil unit, or in steel enclosures. High voltage transformers are available in sizes up to 2000 kva and 15,000 volts.

Hevi Duty Electric Co., Milwaukee 1, Wis.



Lighting Bracket (22)

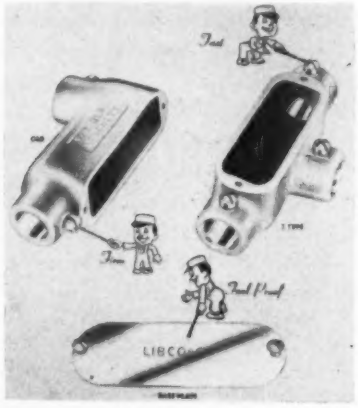
Ornamental lighting bracket, No. 6957. Finish is black and brass. Height is 7½ inches—extends 14 inches. It accommodates 100 watt bulb or PAR lamp and is for use in garages, motels, side entrance of public buildings and such places where ornamental brackets are needed.

Jackson Electrical Co., 900-910 W. Van Buren St., Chicago 7, Ill.

Wire Connector (23)

"Hi-Volt" porcelain wire connector, a "screw-on" type is approved by Underwriters' Laboratories for fixture wiring up to 1000 volts and 600 volts in other applications. Design of molded-in porcelain threads is responsible for extra holding power, including both shape and taper of threads. As connector is screwed-on, it automatically twists the wires together and presses-in threads which are progressively crossed as wires are drawn further into porcelain body. It is made especially for use in cold cathode and slimline lighting fixtures. 1000 volt approval includes 2 or 3 No. 18, 2 No. 16, and 1 No. 18 with 1 No. 16 wires.

Holub Industries, Inc., 413 DeKalb Ave., Sycamore, Ill.



Fittings (24)

New Libcolet EMT set-screw fittings for non-water-tight installations. Bodies are made of cast aluminum with a "silver-lite" finish and are threadless for thin wall tubing. Screws are case hardened, cup-pointed and precision threaded.

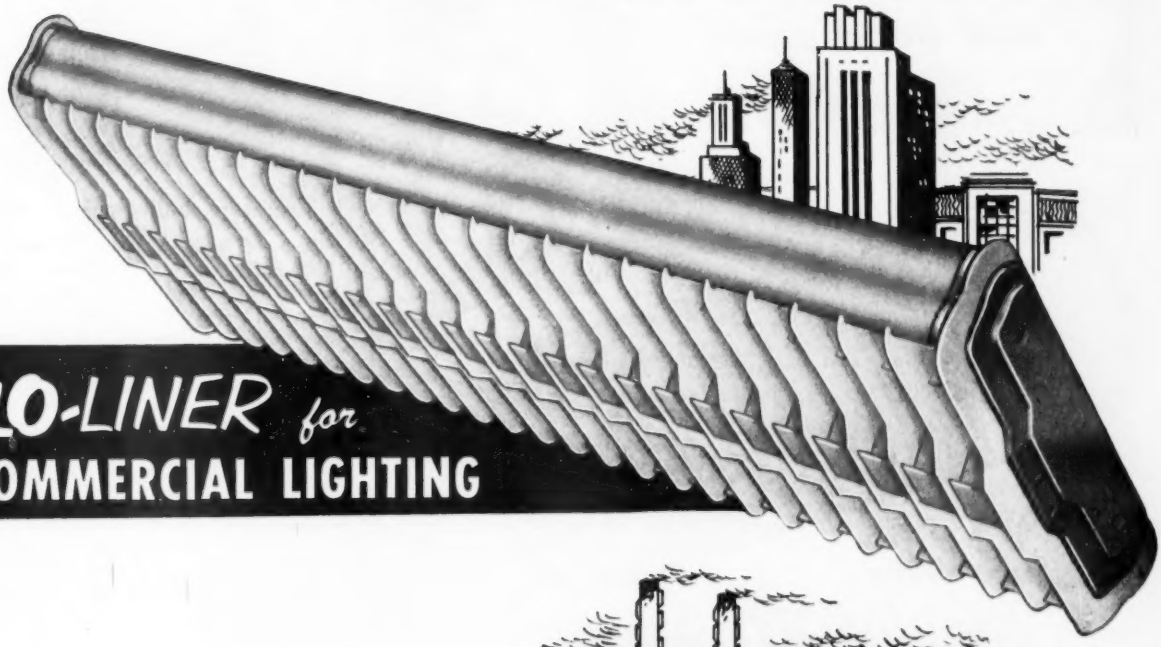
Libco Electric Products Co., Liberty St., Corner Worth, Central Falls, R. I.

(25)

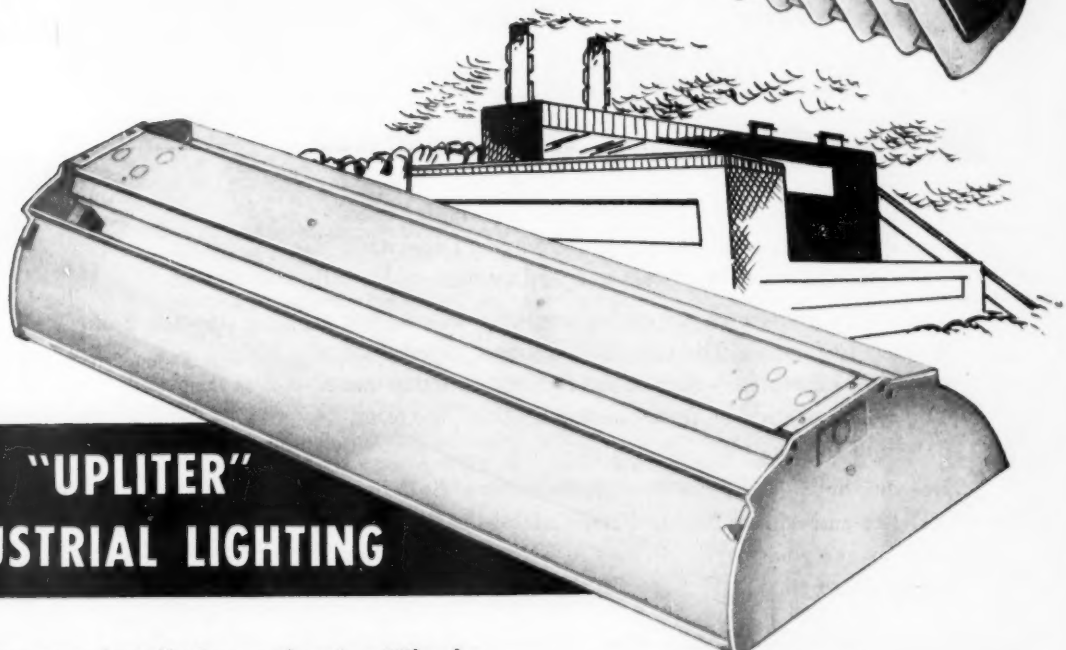
PANELESCENT LAMP has been incorporated as the clock and dial face of a new radio clock. The lamp operates on the principle of electroluminescence, and is no thicker than a pane of window glass. Manufactured by Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.

Whatever your Lighting Requirements...

THERE'S A *Wheeler* FIXTURE THAT'S RIGHT FOR YOU *and the* JOB!



FLO-LINER *for* **COMMERCIAL LIGHTING**



DAY-FLO "UPLITER" *for* **INDUSTRIAL LIGHTING**

Name your installation — there's a Wheeler Fluorescent Fixture to give you maximum lighting efficiency! For 72 years, Wheeler has adhered to the standard of manufacturing only quality lighting fixtures — engineered for ease of installation and proven maintenance savings.

For full information on the above units and the complete Wheeler line of fixtures, write Wheeler Reflector Co., 275 Congress St., Boston 10, Mass.

Wheeler
REFLECTOR COMPANY
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Distributed Exclusively through Electrical Wholesalers

REPRESENTATIVES IN PRINCIPAL CITIES

always
replace with
genuine **Wagner**
Motor Starting Capacitors

Don't take capacitors for granted—when new motor starting capacitors are needed use genuine Wagner Capacitors. Then you *know* that you'll get top performance.

There's no guesswork in replacements when you use Wagner Capacitors. The capacitor number, stamped on the motor nameplate, tells you the right capacitor to use. You're sure of the size, the mounting brackets, the terminals, and the quality.

Do you have Wagner's Fast-Moving Parts Bulletin—MU-122 and Motor Repair Parts Catalog—MU-40? Be sure to get your copies . . . they're a big help for the motor repair shop.

MS53-5

WAGNER ELECTRIC CORPORATION
6413 Plymouth Ave., St. Louis 14, Mo., U. S. A.

Wagner Electric Corporation EST 1891

MOTORS · BEARINGS · STANDARD ROTORS
BRUSHES · CAPACITORS · COMMUTATORS

OVER 750 AUTHORIZED SERVICE STATIONS
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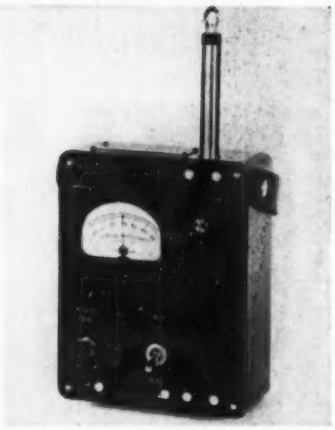
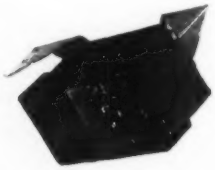


Temperature Indicator (26)

Response to temperature changes in two seconds or less is obtained with Model 328 "Fastherm" temperature indicator. It is a self-contained battery-powered electrical bridge type indicating thermometer. The sensing element is a thermistor, mounted in a protective cage at the end of a retractable prod. When in operating position, prod extends approximately 4 inches above top of instrument case. Retracted, prod and thermistor are entirely within the case. Temperature readings are made on a 2-inch meter with an accuracy of 3% of full scale.

Associated Research, Incorporated, 3752 West Belmont Ave., Chicago 18, Ill.



Switch Box (27)

A new Series 8000 switch box for new work. Box depth adjustment is made easy by $\frac{5}{8}$-in. and $\frac{1}{2}$-in. spacing lines on ends of box. Spacing of $\frac{1}{4}$-in. for wet walls provided by "C" bracket tips. Deep skirt around device screw holes protects against plaster interference with device mounting screws. No external projections. Greater wiring space in ends of box accommodates oversize devices and provides extra wiring room for wires. Listed by Underwriters' Laboratories. Inc.

Union Insulating Company, Inc., P. O. Box 351, Parkersburg, W. Va.

Insulation (28)

An improved line of Class H fiberglas tubing and sleeving, called BH "1151". Insulation is produced in

Why you should use G&W POTHEADS on rubber insulated, shielded, Neoprene jacketed 15 Kv. cables

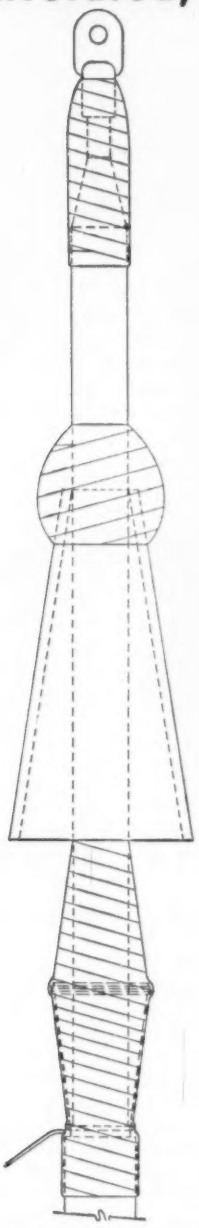


Fig. 1—Cable termination. Exposed insulation subject to deterioration by weather.

Fig. 2—Pothead No. T17231. Permanent protection for cable ends.

Increasing the creepage length on a cable in air beyond a certain distance increases the flashover very little—because ionization of the air (corona) begins at the grounded shielding terminus at the same potential (for a given cable) regardless of the length.

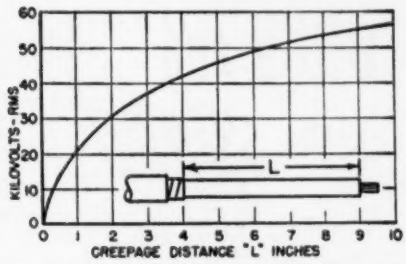
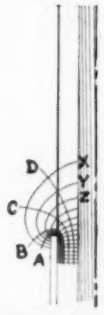


Fig. 3—60 cycle dry flashover values of various lengths of 2/0, 15 Kv., 22/64" rubber insulated cables IN AIR.



Equipotential lines—
A—B—C—D

Flux lines—
X—Y—Z

Fig. 4—Without stress relief cone. High electrical stresses at grounded shielding may cause insulation failure.

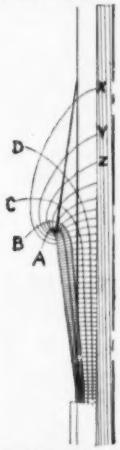


Fig. 5—Stress relief cone decreases radial electrical stresses in the cable insulation but has little influence on longitudinal stresses.

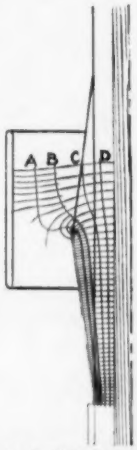


Fig. 6—Further decrease in concentration of flux lines and increase in electrical strength is provided by proper location of grounded pothead body.

A. Exposed insulation surfaces become coated with contaminating dust and in coastal zones salt condensation – which become conducting when wet. As the conducting surface dries unevenly, excessive voltage gradients develop over small areas – arcing can occur and carbonize the organic insulation of a cable termination and result in dielectric breakdown. Inorganic porcelain as used in a pothead is not so affected.

B. The principal benefit of the stress relief cone is in the improved strength of the installation due to an increased resistance to puncture of cable insulation at the grounded shielding terminus where the stress is greatest.

C. Cable surface flashover is increased by the use of insulating compound which has a high dielectric strength compared to air. A pothead provides a container for compound and the compound permits a considerable reduction in the length of the installation.

D. The pothead porcelain provides an outer surface of relatively large diameter compared with the cable, thus reducing the external voltage stresses.

E. High external creepage distance for a given length of porcelain is provided by petticoats which improve the wet flashover characteristics.

F. Potheads (porcelain insulated, compound filled, hermetically sealed) properly protect cable ends against the contaminating effects of weather. G&W potheads meet established A. I. E. E. standards of 60 cycle and impulse voltage withstand values. The extra cost of a pothead (fig. 2) over the cost of materials required for a cable termination (fig. 1) is relatively small – compared with direct and intangible losses resulting from service interruptions due to failures of improperly protected cable ends.

Bulletin AB51 lists potheads with stuffing box seal for Neoprene jacketed cables.

Bulletin A52 gives data on stress relief cones for potheads.

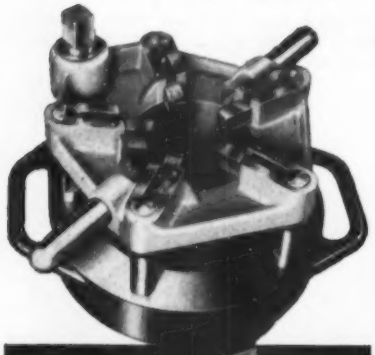
Send for these bulletins.

G & W ELECTRIC SPECIALTY CO., 7780 DANTE AVENUE, CHICAGO 19, ILLINOIS, U.S.A.

preferred everywhere for

ease and speed

in 2½" to 4" pipe work



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NO. 2BR GEARED THREADER

Put this popular Toledo on your 2½" to 4" pipe. Watch it produce perfect tapered threads with *top-speed* . . . and a *minimum of effort.*

EFFICIENT HAND OPERATION . . . Light weight . . . easy handling. Convenient carrying handles. Employs Toledo receding die principle . . . 5 die segments . . . highest quality tool steel . . . three broad faced chuck jaws for easy centering.

HIGH SPEED . . . Operated with a Toledo Power Drive, the 2BR will thread 4" pipe in less than 2 minutes!

ORDER THROUGH YOUR SUPPLY HOUSE . . . Write for catalog 11A-52. The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office: 165 Broadway, Room 1310.

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TOLEDO

PIPE TOOLS . . . POWER DRIVES
. . . POWER PIPE MACHINES

27 sizes from braided fiberglas coated with heat resistant silicone rubber. Its electrical and physical properties are unaffected by continuous operation through a temperature range of minus 90 F to 400 F. It will also withstand 450 F for 96 hours, 500 F for four hours and 600 F for 15 minutes. Silicone coating gives BH "1151" an average minimum electrical breakdown ranging from 7,000 volts for NEMA class H-A-1 to 1,500 for Class H-C-2. In addition to imparting flexibility, heat resistance and electrical strength to all types of glass cloth insulation, SE-100 silicone rubber is useful as an encapsulating material for coils and cores, and as an impregnant for heater ducts, gaskets, seals and diaphragms.

General Electric Co., Pittsfield, Mass.

ing up to 200 megohms. Also included are provisions for resistance testing from 0 to 2,000 ohms. AC voltages are read on three ranges: 0-150, 0-300 and 0-600 volts. DC voltages are metered in ranges of 0-150, 0-300 and 0-600 volts.

All Mail Sales Co., 100 Park Place, New York 7, N. Y.

Tool **(29)**

A new Super Hole-A-Matic self-powered portable hole digging and tunneling machine. It digs holes at any angle from four to eight inches in diameter, up to six feet deep with a shaft extension. For pipe installations, it will tunnel up to 12 feet deep. The specially designed hardened alloy steel blades work with a pulverizing, grinding action. It operates in any remote location from a 1.25 kw ac or dc generator. It can be used on a 115 volt dc or ac, 60 cycles or less, power source. Power unit is equipped with grease-sealed ball bearings and extra heavy windings.

Eugene John Freeman & Co., P.O. Box 2143, Van Nuys, Calif.

Instrument **(30)**

Model 640 Meg-Ohm-Voltmeter provides a 600 volt dc source for insulation testing by means of a hand crank generator. Unit is capable of measur-

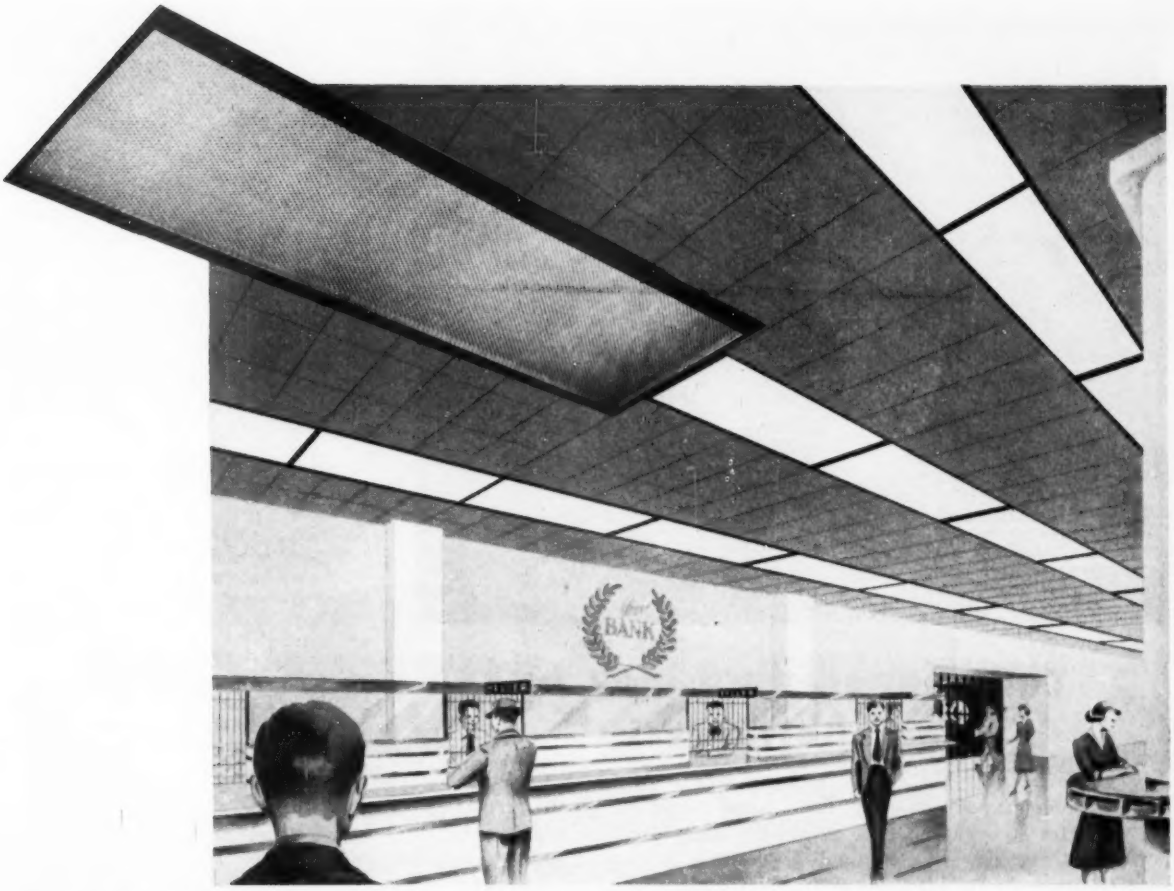
Punch **(31)**

A new hydraulic knock-out punch for piercing holes in thin or thick metal. To operate red cap of return plunger must be fully in, resting on cover. Place top half of die over threaded stem. Set stem through pilot hole in metal to be punched, screw bottom half of die onto threaded stem against metal. Pull out red cap, and operate pump handle until die has pulled through metal. Punch and die are now free of metal and ready to remove punching and return the piston for next operation. Punch will operate horizontally with handle down, vertically, or upside down.

H. K. Caldwell, 4744 Miracle Drive, San Diego 15, Calif.

Product Briefs

(32) A new compact **mobile 2-way radio** featuring Universal 6–12 volt power supply has been announced by Motorola Inc., Chicago, Ill. . . . (33) Model "G-5" **wire stripper** is a rotary stripper using a single razor sharp blade which can be adjusted to within .001-in. It is manufactured by The Eraser Company, Inc., Syracuse, N. Y.



NEW LIGHTING GLASSWARE

gives you low surface brightness...yet delivers maximum light

Can be cut to your specific dimensions:

Now you can provide schools, banks, general offices and public buildings with a truly low-brightness lightweight lens panel.

A new conception in lighting glassware, Corning's Pattern No. 70 low-brightness lens panel reduces brightness by prismatic action in the glare zones. It provides you with brightness and distribution control in all directions through the uniform configuration of six-sided pyramids.

Equally important, new Pattern No. 70 lens panels deliver the maximum amount of light in the useful zones.

Made from engineered glassware, these panels cannot warp, fade or discolor. They add decor to any installation . . . lighted or unlighted.

Color quality is of the most modern standards, and exceptional light weight assures you easy installation. Smooth surface of glass permits rapid, cost-cutting cleaning and maintenance.

Available in lengths up to 100" and widths to 24", Pattern No. 70 lens panel can be cut to your dimensions, giving you freedom of expression in designing applications. They are particularly adaptable in luminous elements, troffers and fixtures where low surface brightness is required. For full information, send for Corning's new Lighting Sales Bulletin. Simply clip and mail the coupon.

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CORNING GLASS WORKS, Dept. EC-9, Corning, N. Y.
Please send me a copy of your new Lighting Sales Bulletin.

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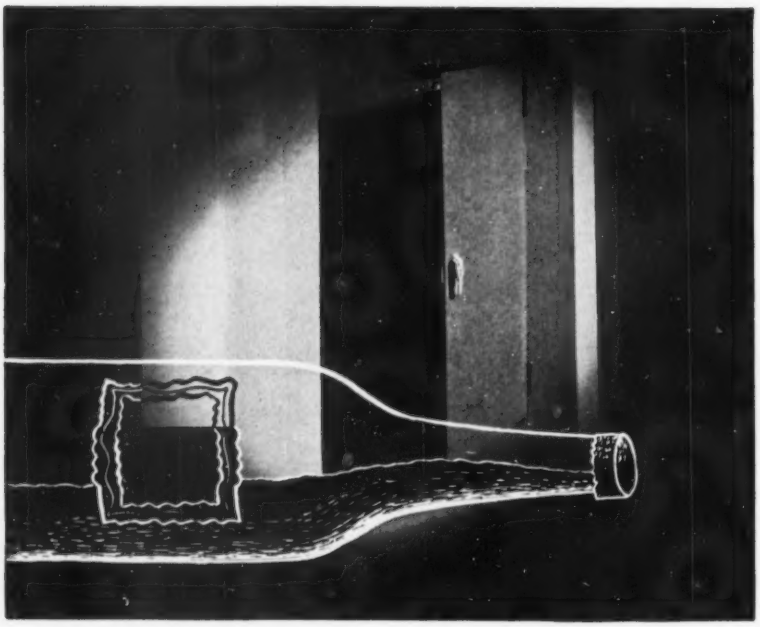


Your panelboard may be your bottleneck

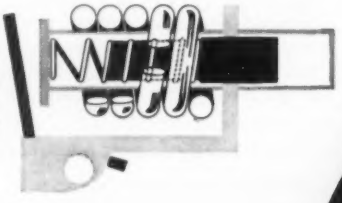
YOUR branch circuits may be wired for 30 or 50 amperes, but do you *really* get that power through your panelboard? Do you have frequent power interruptions during periods of high production . . . particularly in hot weather?

Plant engineers are breaking this nuisance bottleneck by replacing with HEINEMANN Circuit Breakers. The current carrying capacity of HEINEMANN Circuit Breakers does not vary with temperature; nor do the set tripping points. De-rating is never necessary . . . 50 amperes means 50 amperes of usable capacity in your branch circuits. There is never nuisance tripping with the accompanying costly production delays.

HEINEMANN Circuit Breakers operate on a hydraulic-magnetic principle. They provide inverse time delay to allow for starting inrush and harmless, momentary overloads . . . yet they provide the fastest circuit interruption available on large overloads or short circuits.

HEINEMANN Circuit Breakers pay for themselves in another way, too: They have low wattage loss which reduces the current consumption in the panelboard itself . . . a considerable long-term saving.

don't use heat ...USE POWER



Write for Bulletin 3101.

HEINEMANN ELECTRIC CO.
147 PLUM STREET • TRENTON 2, NEW JERSEY

. . . (34) A new line of **power-line carrier equipment,** (Type FD, for power system relaying, telemetering, supervisory control, and voice communication is available from Westinghouse Electric Corporation, Baltimore, Md.

(35) Snap-on Tools Corporation, Kenosha, Wis., has announced a new ½-inch square drive electric **impact wrench.** . . . (36) A new fluteless carbide tipped **drill** has been developed by the Hayden Twist Drill Co., Detroit, Mich., for drilling plastics and shallow holes in cast iron. . . . (37) Detjen Corporation, Electrocuting Fly Screen Division, Pleasant Valley, N. Y., has developed the "Detjen **Insectocutor Lantern"** for the electrocution of night-flying insect pests.

(38) A new "Copper Line" **electric drill kit,** complete with ¼-in. drill and 19 accessories for drilling, buffing, polishing, grinding and wire brushing has been announced by Thor Power Tool Co., Aurora, Ill. . . . (39) Mathias Klein & Sons, Chicago, Ill., offers a new kind of **plier** specially developed for cutting tungsten filaments, music wire, springs and other hard wire. . . . (40) Eutetic Welding Corp., Flushing, N. Y., has developed a new Eutector **Flux** 190NC. It is non-hygroscopic and solves aluminum joining corrosion problems.

(41) Skil Corporation, Chicago, Ill., has introduced a new heavy duty, large capacity saw, the Skil Builders 8¼-inch **saw,** Model 698. . . . (42) A new **silicone resin,** called SR-17, developed by General Electric Co., Pittsfield, Mass., can be used for a variety of insulating applications. . . . (43) "C U B" is a molded tubular **capacitor** developed by Cornell-Dublier Electric Corp., South Plainfield, N. J.

(44) A portable **instrument** for checking the revolutions per minute of motors, machinery, revolving shafts, etc., has been introduced by Montgomery and Co., Inc., New York, N. Y. . . . (45) Mitchell Manufacturing Co., Chicago, Ill., has announced a "magic plug-in" portable **intercommunicator** that requires no connecting wires. . . . (46) Printed Cellophane Tape Co., Los Angeles, Calif. has introduced a printed pressure-sensitive Vinyl (self-adhesive) **tape** for wire, cable and conduit identification.

(47) Hi-G Inc., Windsor Locks, Conn., has developed new miniature high shock **relays** for aircraft, guided missiles, railroad switching devices, computors, navigational and communications equipments, motor starting devices, etc. . . . (48) Alexander Milburn, Inc., Baltimore, Md., has introduced a new high voltage **regulated power supply.** . . . (49) A new ultra-sensitive dc **relay** hermetically sealed with either octal plug or solder terminals has been introduced by Barber-Colman Co., Rockford, Ill.

IT'S THE A.V.C. CONSTRUCTION THAT MAKES THE DIFFERENCE

OUTER FELTED ASBESTOS WALL

VARNISHED CAMBRIC

INNER FELTED ASBESTOS WALL

You can get life-long dependable service under severe operating conditions because these walls of impregnated felted asbestos permanently resist heat and moisture, mechanical damage and effectively seal the high dielectric varnished cambric tapes from deterioration.

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ROCKBESTOS A.V.C.®

(N. E. C. TYPE AVA)

FOR UNINTERRUPTED OPERATION, REDUCED BREAKDOWNS, LOWER WIRE MAINTENANCE COSTS

If HEAT is your problem — Rockbestos A.V.C. (NEC TYPE AVA) is your answer to costly power failures and maintenance down time.

Rockbestos A.V.C. Power, Lighting and Control Cables are designed primarily for installation in high ambient locations and to withstand additional operating hazards such as grease, oil, chemicals and corrosive fumes.

Their dense felted walls of thoroughly impregnated asbestos form a continuous insulation to protect the varnished cambric tapes inserted between the walls of asbestos for higher dielectric strength and added moisture resistance.

Plant layouts and expansion programs are given greater flexibility by installing Rockbestos A.V.C. because not only does it provide greater current carrying capacity for emergency demands and future load growth in existing circuits, but the installation of heat generating equipment is not restricted by its nearness to vital electrical circuits.

Write for the booklet "CUTS CABLE COSTS" which lists the practical advantages of ROCKBESTOS A.V.C. for industrial applications in severe or unusual operating conditions.

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Catalogs, Bulletins and Engineering Data

(50) DISTRIBUTION SYSTEM techniques and equipment; curves, charts and pictures outlining trends to higher kva ratings, higher voltages, underground distribution systems, three-phase transformers, secondary banking, direct pole mounting, solid grounding, and transformer replacement. 24-page booklet. Westinghouse Electric Corp.

(51) PORTABLE TEST UNITS for testing and calibrating current-actuated and protective devices; step-by-step instructions for testing overload relays, circuit breakers, etc., in the field; descriptions of test units and auxiliary ammeters and timers. 12-page illustrated booklet. Multi-Amp Corp.

(52) PUMP MOTORS for hollow and solid shaft vertical pumps; illustrations show types of enclosures available and varied uses of the motors in industry; four-color cutaways and phantom drawings give details of the non-reverse ratchet, types of oil- and grease-lubricated thrust-bearings available, and specific features of construction. Bulletin No. 1250, Louis Allis Co.

(53) ARC WELDERS, including dc motor-generator and engine-driven sets, dc selenium rectifiers, and ac transformer welders; discussions of various types of running gear, foot controls and an automatic arcwelding head; complete descriptions covering specifications, features and electrical data. 44 page catalog. Air Reduction Sales Co.

(54) ELECTRIC HEATING UNITS, including strip, cylindrical, ring, cartridge, tubular and immersion heaters, package sealing devices, hot plates, thermostats, rheostats, switches, contactors, condensers, insulators and leads; typical applications; engineering data section presenting such topics as Methods of Transmitting Heat, How to Determine Wattage Requirements, and Energy Required for Heating Air and Water. 1953 tab-indexed catalog. Watlow Electric Mfg. Co.

(55) POWER TOOLS; illustrations, descriptions, specifications and prices of drills, grinders, hammers, saws, screwdrivers, nut setters, sanders, polishers, tappers, nibblers, balancers, impact wrenches, automotive valve refacers, etc. Thor Power Tool Co.

(56) AIR HANDLING UNITS for industrial and commercial heating, ventilating and air conditioning applications; detailed installation possibilities for central plant air conditioning, exhausting heat fumes or vapors, and heating and ventilating requirements where cooling is not needed; description of accessories, including humidifiers, mixing boxes and filter sections. 6-page bulletin. Westinghouse Electric Corp.

(57) CHRISTMAS DECORATIONS; descriptions and illustrations of illuminated decorative plaques, tree sets, electrified wreaths, candles, cord sets and flashers. Dealer catalog. Gem Electric Mfg. Co.

(58) FAN ENGINEERING MANUAL; details for calculating duct sizes, friction losses, performance and horsepower requirements; engineering, installation and operating data for all standard and special-duty fan applications. 64-page manual. Aerovent Fan Co.

(59) CURRENT TRANSFORMERS, indoor type, for operating watthour meters and instruments; application, construction features, accuracy ranges, thermal rating, and various engineering and design aspects. 4-page bulletin. General Electric Co.

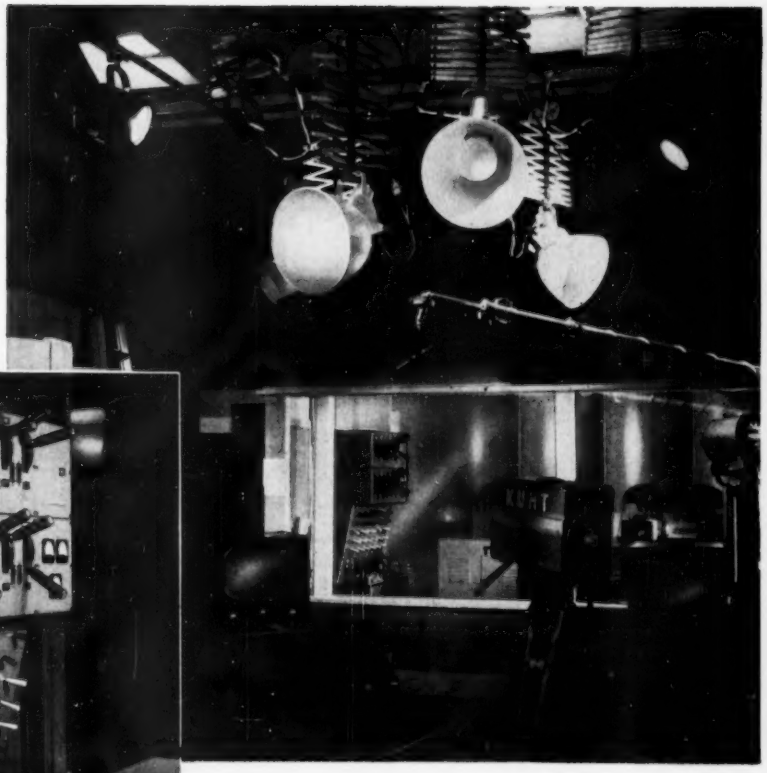
(60) HANGERS AND SUPPORTS for electrical conduits, cable and outlet boxes; description of supports for suspended-ceiling wiring, for supporting conduits and outlet boxes in concrete pour, for recessed lighting. 6-page bulletin. Fast-Lok Manufacturing Co.

(61) DC MOTORS AND GENERATORS with photographs and cutaway drawings showing details of mechanical construction, available motor enclosures for different operating conditions; section on motor-generator sets; text and diagrams describing dc electrical characteristics, the features, advantages and application of shunt, series, and compound motors. 16-page bulletin. Louis Allis Co.

(62) LAMP GROUP REPLACEMENT plans currently in effect in several large industrial manufacturing plants; benefits and features of two recommended plans: group replacement when the lamps have burned a fixed percentage of their rated average life, and group replacement when lighting has dropped to an established minimum

Note dimmer board in the control room. Station KUHT-TV is managed by Mr. John C. Schwarzwalder. It is a venture of the University of Houston and the Houston Independent School District. The University has an enrollment of over 10,000 students. Its president is Dr. W. W. Kemmerer.

The Packaged POWERSTAT Dimmer board installation at KUHT-TV, built by the William E. Powell Mfg. Co. of Houston, Texas, consists basically of two Packaged types DCS6-2000 units mounted above a bank of single pole double throw switches.



big-budget TV studio lighting

obtained with low cost powerstat dimmers

Money was an object at KUHT-TV when it came to planning the studio lighting circuits — so was top performance. Consequently Mr. George L. Collins, art director, selected Packaged POWERSTAT light dimming equipment when he designed the board. By so doing he obtained the finest light control equipment at the lowest cost consistent with such quality.

The final arrangement provides almost unlimited flexibility and, when production permits, one bank of dimmers can even be used as a pre-set board.

Each Packaged POWERSTAT Dimmer is a complete switchboard in itself. It can also be used in combinations for greater capacity. KUHT-TV uses two of these packaged units, mounted one on top of the other, to control a multitude of lighting load circuits that is much in excess of the available dimmer circuits.

The standard line of Packaged POWERSTAT Dimmers can be adapted to meet complex light dimming requirements. Lighting engineers of The Superior Electric Company welcome the opportunity to help you plan an installation that is simple to install and to operate — with your budget fully in mind.

VOLTBOX A-C POWER SUPPLIES
POWERSTAT VARIABLE TRANSFORMERS
VARICELL D-C POWER SUPPLIES

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STABILINE AUTOMATIC VOLTAGE REGULATORS
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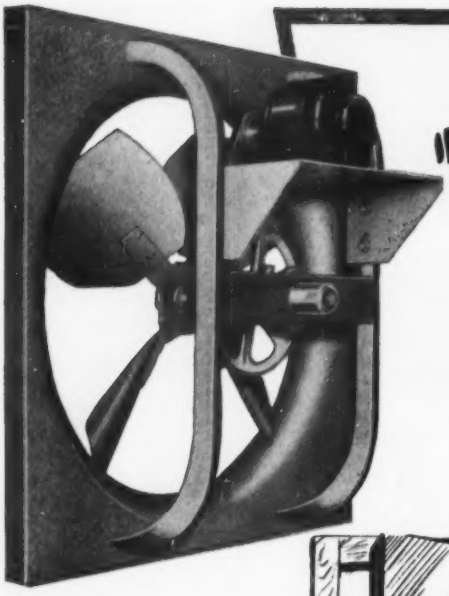

The "Package" FAN is the Easiest to Install

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LIVE UP TO THEIR PERFORMANCE PROMISE, TOO!

- Compact, ruggedly built —accurately rated capacities.
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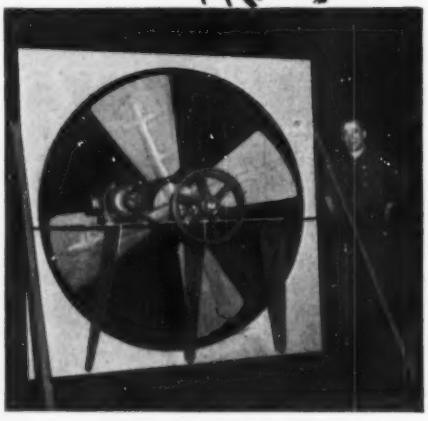
- 24", 30" and 36" Fans can be operated at any angle from vertical to horizontal, discharge up.
- WRITE FOR DETAILS ON THESE PROFITABLE, EASY-TO-HANDLE FAN UNITS.



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level. 10-page publication lists benefits of group replacement of lamps in factories, offices and stores before burnout. General Electric Co.

(63) MODULAR LIGHTING UNITS for recessed mounting in suspended ceilings in multiples of 1'x4', 2'x4' and 4'x4'; ballast and lampholders are contained in individual housing. 8-page folder. F. W. Wakefield Brass Co.

(64) POWDER-ACTUATED TOOL applications manual; photographs and cutaway sketches showing use of tools and fasteners in building, construction and maintenance fields, marine, electrical, air conditioning, plumbing and masonry; specifications on more than 20 fixtures and accessories and 56 drive pins and threaded studs; selection tables set forth proper fastener and charge for various receiving materials. Ramset Division, Olin Industries.

(65) PLANNING GUIDE for light-duty overhead ac secondary network system; check list of data required in making a system study preliminary to planning a layout. Westinghouse Electric Corp.

(66) SCHOOL LIGHTING theory and practice; discussion of such topics as quantity and quality of light and brightness contrast, comparative costs of incandescent and fluorescent lighting, various types of lighting systems, and recommended levels of illumination in classrooms, auditoriums. 16-page booklet. Sylvania Electric Products, Inc.

(67) ELECTRIC HARDWARE and accessories including screw anchors, masonry drills, wire strippers, wire connectors, fish tape and reels, voltage testers; descriptions and prices. 4-page bulletin. Holub Industries, Inc.

(68) MAGNET WIRE INSULATION for Class B applications where high operating temperatures are encountered; results of electrical tests determining aging, voltage at failure, and flexibility and adherence of insulation; table of average dimensions of square magnet wire with various insulation. 4-page bulletin. John A. Roebling's Sons Co.

(69) MEASURING EQUIPMENT; information on more than 115 testing and measuring devices for laboratory and production line use including such equipment as simple current indicators, surface roughness scales, dc amplifiers, completely automatic oscillographs, mass spectrometers and radiation monitors; descriptions of each product and its field of application, condensed tables of characteristics, prices. 64-page catalog. General Electric Co.

(70) SNAP-ON LOUVERS for single-lamp fluorescent fixtures in either clear plastic or opal colored plastic;

description and illustrations; dimensions, coefficients of utilization, prices. 4-page bulletin. House-O-Lite Corp.

(71) LIGHTING FIXTURES for Class I, Groups C and D hazardous locations; description of components, performance data, and methods of installing or relamping explosion-proof, weather-resistant incandescent fixtures. 4-page bulletin. Crouse-Hinds Co.

(72) PANELBOARDS, distribution panels, safety panels, switchboards, cabinets and pull boxes; complete descriptions, sketches, specifications and prices. 42-page catalog. Kinney Electrical Mfg. Co.

(73) MOTOR STARTERS in NEMA sizes 0, 1, 2, 3, 4, 5, and 6 to 400 hp, 600 volts ac with either local, remote or selector switch control; combination magnetic starters and disconnect switches or magnetic starters and thermal-magnetic industrial circuit breakers; photographs, specifications and dimensioned sketches. 8-page bulletin. Federal Electric Products Co.

(74) METAL CUTTING with hand and power hack saws and band saws; includes rules for selecting and using hack saw blades and frames, right and wrong way to saw a piece of metal, causes and cures for blade trouble, selection and use of power hack saw blades, and right and wrong way to adjust a band saw blade; prices and specifications of saw blades. 28-page illustrated booklet. Clemson Bros., Inc.

(75) TELEMETER MULTIPLEXING SYSTEM; description of new system for transmitting up to 15 readings (over a single circuit) of pressure, vacuum, temperature, flow, water or liquid level, static and differential pressure, motion, voltage, current or totalized load taken at separate locations or areas to receiving instruments. Bulletin No. 742. The Bristol Company.

(76) LIGHTING FIXTURES for ranch-style homes; incandescent units with plastic shades and keyless or turn knob sockets, trimmed in chromium and brass; illustrations, descriptions and dimensions. 4-page bulletin. Markel Electric Products, Inc.

(77) ELECTRONIC CONTROL HANDBOOK; 46 new case studies explaining how standard packaged electronic controls have solved problems of weighing, counting, measuring, timing and cycling. Photoswitch, Inc.

(78) INSULATED ALUMINUM CABLES; latest information on properties, problems and advantages; resistance ratios, current carrying capacity conversion factors; size comparisons for equal voltage drops; selection of time tests under electric load showing relative

General Electric Announces a really NEW Water Cooler!

You've never seen a water cooler like this before—styled to fit the smartest showroom, yet rugged enough to take hard use in a plant. It's the all-new Diamond Anniversary G-E Water Cooler sparkling with far-ahead features.

NEW COMPACTNESS, requires 30% less floor space.

NEW SERVICING EASE, all adjustments made through snap-off front.

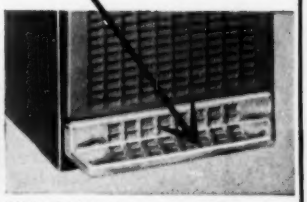
NEW COOLING DEPENDABILITY because it features the famous G-E compressor—as used in G-E household refrigerators (over 3,500,000 in service 10 years or longer).

NO SQUIRT, NO SPLASH, NO SPILL, thanks to G-E automatic air-pressure vent, deep-dish basin, and non-squirt bubbler.

LEARN HOW YOU CAN EARN extra income without extra overhead by selling the G-E Water Cooler line. Send in the coupon, or contact your G-E wholesaler.

COMPACT! TAKES 30% LESS FLOOR SPACE without sacrificing capacity or efficiency.

CLEAN AND SANITARY. Electro-polished anti-splash top and gray hammered finish resist soiling.



EASY TO USE. Unit is activated by giant-width foot pedal, directly linked to valve. No groping, even in the dark.

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General Electric Company, Air Conditioning Division, Section EC-17, Bloomfield, New Jersey

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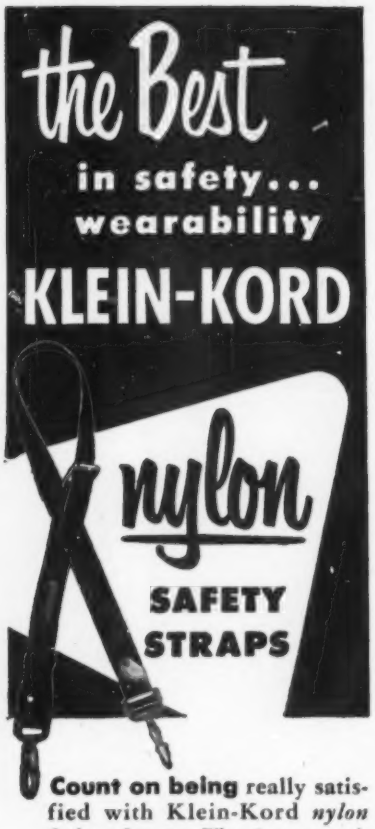

Count on being really satisfied with Klein-Kord *nylon* Safety Straps. They're smooth and flexible, require no special care—and give you that important extra margin of safety. Made of multiple plies of strong, finely woven *nylon*, bonded together with frictioning and vulcanized in neoprene. Red center is a safety signal to "Stop When You See Red!" Equipped with finest drop-forged hardware.

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KLEIN *Nylon* CLIMBER STRAPS

for calf and ankle also available. Special straps furnished with rivets, burrs and punched for quick attachment to ring type climbers.

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merits of various fittings for aluminum conductors. 16-page booklet. Okonite Company.

(79) SELF-POLICING ANNUNCIATORS for industrial alarm systems; wiring diagram, sequence listings and specification instructions. SCAM Instrument Corp.

(80) MOTOR SERVICE PLAN for fractional- and integral-hp motors and generators; types of service provided, service warranties and motors covered; listing of authorized service stations. 4-page bulletin. General Electric Co.

(81) DRY TYPE TRANSFORMERS for power and lighting circuits, electric furnace control, phase changing, indoor sub-stations, machine control circuits and motor starters; photographs and descriptions. 5-page bulletin. Hevi Duty Electric Co.

(82) TOWER LIGHTING: methods and materials necessary for installing obstruction lighting equipment on radio, television and microwave relay towers; includes layout drawings with complete bills of material for lighting towers of all heights. 20-page booklet. Crouse-Hinds Co.

(83) LIGHTING UNITS; illustrations, descriptions, dimensional data, lighting curves and other detailed data on incandescent and fluorescent fixtures for commercial, industrial and outdoor use. 80 pages. Electro Silv-A-King Corp.

(84) ELECTRICAL INSULATION; complete source of price information on such material as cords and twines, untreated woven tapes, sleevings and tubings, paper and paper products, slot wedges, reinforced or laminated plastics, vulcanized fibre, plastic or resinous films, pressure-sensitive tapes, varnishes and compounds, mica products, varnished fabrics and paper combinations, and miscellaneous materials; 140-page catalog. Insulation Manufacturers Corp.

(85) TIME CONTROLS for farm electrical equipment; descriptions of such applications as artificial lights for poultry farms, mechanical poultry feeders, milk house water heaters and ventilators, silo unloaders, hay driers, feed grinders and mixers, yard lights and well pumps. 14-page booklet. Paragon Electric Co.

(86) DRY TYPE TRANSFORMERS for reducing 240, 480 or 600 volts to 120 or 240 volts, with or without taps, 25, 50 or 60 cycles; photographs, diagrams, prices and dimensional data. 8-page booklet. Hindle Transformer Co., Inc.

(87) BELT CENTER CALCULATOR for finding distances between shaft centers and checking equipment clearances, accurate to $\frac{1}{8}$-inch; data sheet giving NAFM and NEMA fan and motor data. Korfund Co., Inc.

(88) CLUTCH CONTROLS for power machines including single stroke control, automatic cycling control, hand and foot switches, limit switches, clutch actuators and solenoid air valves; photographs, dimensions and specifications. 12 pages. Micro Switch.

(89) RESONANT TACHOMETERS for the measurement of speed of rotating machinery from fractional-hp motors to large turbines; description of the principles of operation; photos of instruments available. 16-page bulletin. James G. Biddle Co.

(90) CONTROL SYSTEMS at 720 cycles for off-peak control of water-heating loads; information on station equipment, coupling equipment, and load switches; specifications of load-control units, converters, couplings, capacitor reactors, and test equipment. 28-page bulletin. General Electric Co.

(91) WIRING MODERNIZATION promotional kit for electrical contractors, distributors and utilities; information on building home rewiring, farm rewiring, and industrial and commercial rewiring business. 16-page brochure. Anaconda Wire & Cable Co.

(92) STEEL SHOP EQUIPMENT including laminated wood top benches, smooth top steel benches, work stands, machine stands, tote boxes, welding benches and accessories; description of construction, styles, sizes and other data. 8-page bulletin. Industrial Bench and Equipment Mfg. Co.

(93) ELECTRIC MINING EQUIPMENT for pit operations, transportation, milling and concentrating, townsite planning, and power generation and distribution; description of application of electric power to iron ore projects. 20 pages. Westinghouse Electric Corp.

(94) AUTOTRANSFORMER DIMMER for low capacity circuits in homes, schools, churches, restaurants and night clubs; photographs, dimensioned sketches, outstanding features. 4-page bulletin. Ward Leonard Electric Co.

(95) PHOTO-RECORDING MANUAL; complete review of the problems and associated solutions encountered in photographing cathode-ray patterns; illustrated with photo-recordings, scales, graphs, and diagramatic sketches; descriptions and specifications of photo-recording equipment. 36 pages. Allen B. Du Mont Laboratories, Inc.

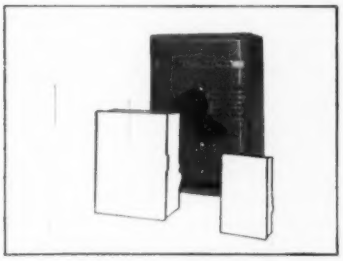
(96) RLM STANDARDS Specification Book, 1953 Edition; three officially-approved new specifications for semi-

3 Complete Lines

OF TRUMBULL SAFETY SWITCHES

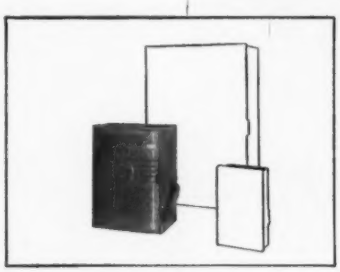
to fit practically any low voltage application with a new high in dollar value

When you select a switch from this complete and superior Trumbull line, you can be sure of getting the best possible device for a clearly defined type of service—and the best combination of favorable first cost and continuing economy of operation.



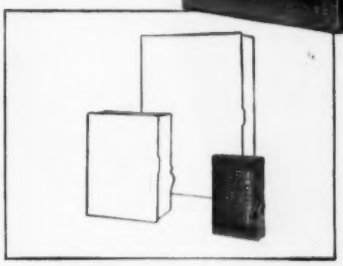
***HEAVY DUTY INDUSTRIAL**
Exceeds NEMA Type A Standards

The Trumbull Style HCI Front Operated Safety Switch is without any question the finest switch ever built by Trumbull, the Safety Switch leader. It has every installation convenience, every operating and maintenance advantage, and all the protection we know how to build into a switch. Its unique and thoroughly proved pole units introduce a basically superior switching principle. It is deliberately designed and built to exceed today's requirements and last as near to forever as a switch can.



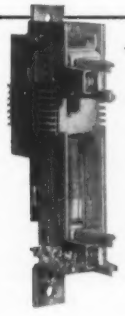
***STANDARD DUTY**
Meets NEMA Type A Standards

The Trumbull Style HCI Side Operated Safety Switch will meet all but the most rugged demands with *plenty* to spare. It features the HCI pole unit with circuit breaker arc quenching action. While it meets NEMA Type "A" specifications it offers substantial cost savings. No Trumbull safety switch ever offered more for the money.



GENERAL USE
Meets NEMA Type D Standards

The Trumbull Style D Safety Switch is designed for many applications where service is not severe and continued overloads unlikely. This well-engineered and sturdily built switch does its job at real savings in first cost. It is suited for use in many distribution and branch circuits, for flood or sign lighting, service entrances, heating and air conditioning equipment.



***The pole units** *of Style HCI switches feature the magnetic-repulsion principle of arc-quenching, similar to that of a modern circuit breaker. Grid pins break up and quickly dissipate the arc. Double-break visible contacts are actuated by a heavy spring, with practically instantaneous make and break. These exclusive features result in high interrupting capacity and longer switch life.*

There is a Trumbull safety switch to meet practically any application up to 1200 amperes, 600 volts AC or DC.

TRUMBULL T ELECTRIC

DEPARTMENT OF GENERAL ELECTRIC COMPANY
PLAINVILLE, CONN.

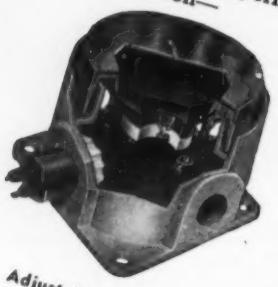
FULLMAN **Latrobe**
Electrical Products

Floor Boxes and Wiring Specialties

ADJUSTABLE WATERTIGHT FLOOR BOXES
•
NON-ADJUSTABLE WATERTIGHT FLOOR BOXES
•
ADJUSTABLE GANG FLOOR BOXES 1-2-3 AND 4
•
FLOOR JUNCTION BOXES

FULLMAN MANUFACTURING CO. QUALITY AT LATROBE SUPREMACY LATROBE, PA.

For long, smooth service "Latrobe" Floor Boxes and Wiring Specialties are tops. Years of performance have proved that. And, "Latrobe" Boxes are designed in a way that permits fast, easy installation—



Adjustable Watertight Floor Boxes

"Latrobe" Adjustable Watertight Floor Boxes are now equipped with a positive electrical bonding wire, which make them fire-proof. Come in singles, two, three and four gang.

Pipe or Conduit Hanger

Sturdy and dependable for hanging pipe or conduit ⅛", ¾" and 1" to steel beams up to ⅜" thick. Larger sizes for larger pipe.

Visit our Booth at the National Electrical Industries Show, 69th Regiment Armory New York, Sept. 29th to Oct. 2nd.

UTILITY OUTLETS
•
NOZZLES AND FLOOR BOX ACCESSORIES
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INSULATOR SUPPORTS
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PIPE AND CONDUIT HANGERS
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ARMORED CABLE SUPPORTS
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CABLE CLIPS
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STAPLES
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FISH WIRE

Fullman Manufacturing Co.
1209-1215 JEFFERSON STREET
LATROBE, PA.

direct industrial fluorescent lighting units; important revisions and clarifications of existing specifications including new tables of typical coefficients of utilization and light distribution curves. RLM Standards Institute.

(97) PACKAGED DRIVES for variable speed applications; construction and operation, typical applications, economics of operation of adjustable-voltage drives; description of special operating characteristics such as inching, reversing, dynamic braking and multi-motor control. 16-page booklet. Westinghouse Electric Corp.

(98) CONTROL PANELS utilizing visual aid techniques to present process information to the operator; photographs of applications in power stations, petroleum refineries, chemical and process industries; descriptions of graphic panel components. 4-page bulletin. Panellit, Inc.

(99) SELENIUM RECTIFIERS for electroplating and anodizing; descriptions of basic units, remotely controlled units, and power supplies for plating and anodizing, solution analysis, laboratory research and development. 8-page booklet. Accurate Engineering Co.

(100) MAINTENANCE WELDING for the oil industry; discussion of various salvage and maintenance applications from drill bits to crown block to show precautions and procedures recommended for efficient welding operations in this industry. 4-page folder. Eutectic Welding Alloys Corporation.

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THEY'LL GROW FROM THIS

TO THIS

BEFORE YOUR WESTINGHOUSE FLUORESCENT LAMP BURNS OUT

Yes, the standard Westinghouse Fluorescent Lamp lasts for years in the average home. In fact, based on the rated life of 7500 hours, this means 3½ years in an office or factory.

And these durable lamps are easier, safer, and more convenient to install! Only Westinghouse Fluorescent Lamps have the special conical Indicator Base that saves installation time—and thus money.

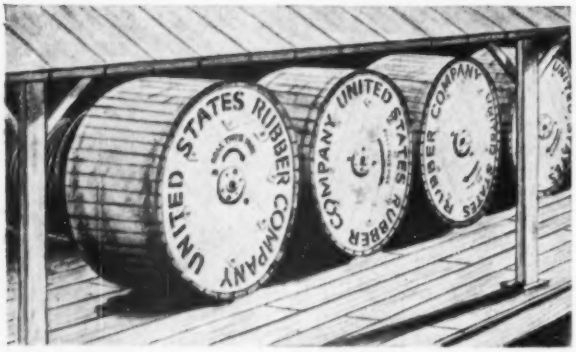
For details contact your Westinghouse Lamp Supplier or write Westinghouse Lamp Division, Bloomfield, New Jersey.

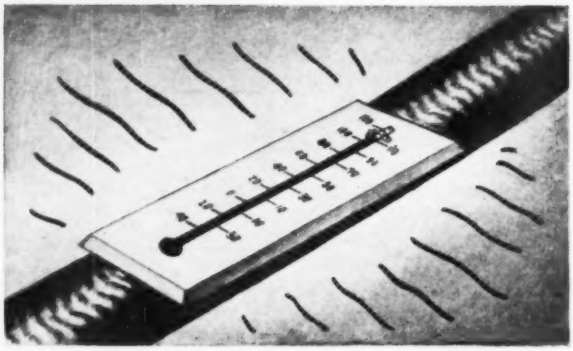
Tune in each week on TV... Westinghouse Pro Football... Westinghouse Studio One

Give blood now! Call your Red Cross today.

YOU CAN BE SURE...IF IT'S Westinghouse

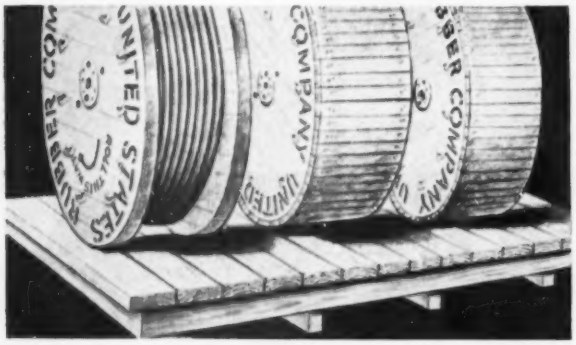
How to prolong the life of wire and cable by proper storage

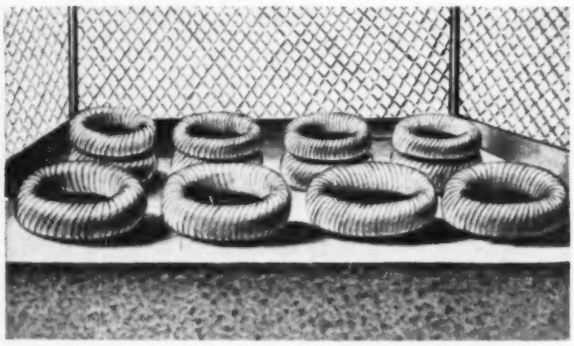




1 **Protect cables from the weather.** Moisture is especially injurious to fibrous coverings. When stored out-of-doors, if they become wet and then freeze, they will be weakened and the saturant will flake off. In humid weather, mold growth is accelerated, weakening the covering and making it easier to damage the cable during installation. (Rubber and thermoplastic insulated and jacketed cables may be stored under moderately humid conditions.) The larger sizes of fibrous covered and rubber jacketed cables and all lead-sheathed rubber insulated cables must be stored on reels which must be properly lagged—or the cable must be otherwise suitably protected against mechanical damage. Reels can be stored out-of-doors if the cable is protected against sun and weather, and the ends are properly sealed.

2 **Don't expose wires and cables to extremes of temperature.** Chemical reactions occur at a higher rate at high temperatures than low. The greatest deterioration of low-voltage cables is due to chemical changes, oxidation or internal changes in the compound itself. Never store reels in the boiler room unless you use a fan to blow hot air away from the wires and cables. It's best to store cables at room temperatures indoors out of direct sunlight. Rubber insulated cables may be stored and handled without damage at the lowest temperatures ordinarily encountered, but thermoplastic synthetic insulated cables should not be handled at temperatures below –10 C. (14 F.)





3 **Reels should be kept off the ground,** so that moisture will not harm the cables, reel flanges and lagging. Sound reels are easier to handle and there is less chance of injury to the cable as it is removed from the reel.

4 **Coils should be stored one layer deep on the floor or shelves,** with the axis either horizontal or vertical. To save space, they may be stacked, but not more than 5 coils in height—otherwise there is harmful pressure on the insulation. Don't remove brown paper or box that protects against dust and light until used.

5 **Rubber insulated fibrous covered, rubber jacketed or lead-sheathed cables in storage** should never be bent to a diameter less than I.P.C.E.A. recommended diameters. Never let coils or reels drop more than a few inches. Always roll a reel in the direction indicated by the arrow on the flange. When rolling an unlagged reel, put planks under the flanges to avoid pressure on the cable. Coils, reels and spools should always be rotated when wire and cable is removed to avoid twisting the cable.

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UNITED STATES RUBBER COMPANY

U.S.RUBBER
SERVING THROUGH SCIENCE

Electrical Wire and Cable Department

ROCKEFELLER CENTER • NEW YORK 20, NEW YORK

QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

Reader's Quiz

Refining Transformer Oil

QUESTION T23—In the process of refining transformer oil, I have used the press on energized 2300 volt transformers. Would it be advisable to do this cleaning process on 23,000 volt energized transformers? Oil is taken at the bottom, passed through a filter press and pumped to the top opening. Would there be danger of moisture in cleaning on the high voltage transformers?—E.S.H.

ANSWER TO T23—Transformer oil may be filtered while equipment is energized if certain precautions are taken. Oil must be drawn from bottom of tank, passed through filter, and returned to top of tank. *Return must be beneath surface of oil in tank to prevent aeration,* which could cause serious trouble.

Filtering should be done by a standard blotter type press. Metal or oil proof hose must be used. New neoprene hose may be used, but never a natural rubber hose, as natural rubber contains oil contaminating sulphur. When filtering with blotter press, it is advisable to renew the blotter sheet nearest to oil inlet at least every half hour unless pressure guage on filter holds even reading indicating that this is not required.

Other facts concerning oil and filtering: Reconditioned oil should have minimum dielectric strength of 22 kv using standard test procedures.

Transformer oil in use has a progressive decrease in demulsibility and increase in organic acidity which cannot be corrected by blotter filter. Oil should be tested at frequent intervals, and corrected by chemical means or replaced.

The blotter filter will remove small quantities of water, also finely divided carbon and sludge. Large quantities of water must be removed by centrifuge. Blotter filter will not materially reduce organic acidity or improve resistance to emulsification, except as latter is caused by presence of carbon, although the dielectric strength may be restored to a satisfactory value.

The fastest method of filtering is to pump oil to another container and back, filtering both ways. If this is not practical, then the circulating method must be used, although this involves greater time.

To prevent possibility of moisture as mentioned in question, filter press should be located in a warm dry place, blotters should be dried in oven and stored in oven until ready to use, and should be replaced frequently while filtering even if clean, as dirt is indication of carbon only not of moisture. —E.J.S.

ANSWER TO T23—It is standard practice to treat oil of energized transformers, either to remove water or to improve the neutralization number, IFT, etc.

Large power transformers, 3,000 to 12,000 kva, with primary voltages up to and including 111,000 volts are so treated. On one occasion a water cooled power transformer with a 110,000 volt primary was kept in service with a leaking water coil for four (4) days by filtering the oil day and night until the transformer could be taken out of service.

Among the precautions that should be observed are:

Both filter press connections should be below the top oil level.

HIGH-VOLTAGE TEST unit is easily rolled to the work in the motor repair division of the Lima Armature Works, Lima, Ohio. Portable cabinet (60"x36"x 35") contains transformer with necessary tap changing equipment to provide test voltages up to 18,000 volts. Mechanic is making insulation test on winding of a 125 hp, 2200-volt, 3-phase synchronous motor.

Oil should be drawn from the top connection and returned to the bottom connection. This is to prevent either entrained air (air bubbles) or drops of water from lowering the dielectric strength of the oil at the transformer terminal board. Either drops of water or air bubbles at this location might result in a flashover.

Careful attention should be paid to the oil level during the treating process. It is best if the transformer being treated be equipped with a low oil level alarm.—J.B.P.

Rewinding Motors With Silicone Insulation

QUESTION U23—Some motor repair shops rewind motors with silicone insulation and claim they can make a 50 hp motor do the work of a 75 hp motor. In a case such as this how does that affect the efficiency, slip, power factor and mechanical strain on the motor?—M.D.

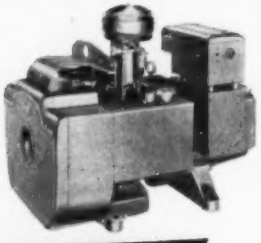
ANSWER TO U23—We have done investigation along this line of uprating motors using silicone insulation and have run dynamometer tests on smaller frame size motors. For example, on a 284 frame totally enclosed fan cooled motor 7½ hp at 1800 rpm, the new motor showed the following characteristics: 82% efficiency, 93% power factor, and a speed of 1750 rpm at its nameplate rating. This same motor when operated at 50% overload showed the following characteristics: 76% efficiency, 92% power factor, and ran at 1680 rpm.

We then stripped the original winding and rewound this unit with silicone insulation, reduced the number of turns by 20%, and increased the wire size by 1 AWG number, and obtained the following characteristics with the motor delivering 14 hp and after temperature had stabilized: 79% efficiency, 88% power factor, and it was operating at 1735 rpm.

There have been a number of actual industrial applications where motors have been rewound with silicone insulation and the load on these units has been increased by as much as 50% and satisfactory operation was obtained. An example of this is 28-50

The STANDOUT ELECTRIC PLANT for STANDBY ELECTRIC POWER

the New
ONAN "CW"
(5,000 & 10,000 WATTS)



QUIET RUNNING

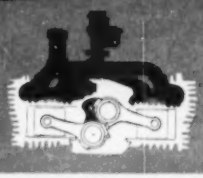
10CW—*10,000 watts A. C.*
High standby capacity for hospitals, hatcheries, schools, stores, plants.

5CW—*5,000 watts A. C.*
For homes, farms, police radio, micro-wave relay stations, etc.

COMPACT

Takes less than one cubic yard of space. 10KW model requires only half the space of ordinary 10,000-watt plants. Easier to install. Connection box provided for quick hook up.

BUILT FOR HEAVY DUTY



Smooth running twin-cylinder, horizontally-opposed, 4-cycle air-cooled engines deliver rated horsepower at moderate speed. Unusually large bearing surfaces for long life

UNI-DUCT COOLING

Cooling air is drawn by vacuum through generator and over engine. All heated air expelled through one small vent which also discharges engine exhaust. Quiet operating.

DE LUXE EQUIPMENT

Nothing extra to buy. Impulse-coupled, high-tension magneto, radio shielded. Oil-bath air cleaner, fuel filter, oil pressure gauge, fuel tank, muffler and exhaust tubing.

COSTS LESS THAN ANY OTHER COMPLETE ELECTRIC PLANT! The Onan "CW" combines exclusive design advantages with all the time-proved Onan features such as UNIT-BUILT CONSTRUCTION, *yet it costs less.* Get the complete story of this sensational, all-new electric plant.

Write for detailed specifications!

D. W. ONAN & SONS INC.

Onan ELECTRIC PLANTS

829d UNIVERSITY AVENUE S.E., MINNEAPOLIS 14, MINNESOTA

hp motors operating high pressure pumps. These units were rewound with silicone insulation and are now operating at a continuous load of 75 hp with occasional peak loads of 86 hp. These units have been operating satisfactorily for four years.

As far as mechanical strain on the motor when operating at this increased load, we know of no cases where the increased load has damaged the motor in any way mechanically. Of course, to deliver a 50% increase in hp there is a 50% increase in torque on the motor shaft but in general a motor is designed so that it can easily withstand a 50% increase in torque on the shaft as far as a continuous mechanical load is concerned. It would be more likely that sudden mechanical shocks such as instantaneous braking would damage the motor mechanically. —G. E. M.

Converting DC Motor To Generator

QUESTION V23—In our power plant we have an old 200 hp 250 volt, 650 rpm dc motor. Could we drive this machine at 1200 rpm to secure 500 volts output?—W.P.R.

ANSWER TO V23—It is presumed from the question that it is desired to operate the motor as a generator. If the machine is compound wound, it will be necessary to reverse the series field, but not the commutating field, coils if a cumulative compound motor is to be used as a cumulative compound generator.

Doubling the voltage could be accomplished either by doubling the speed or doubling the field current. Doubling the speed may bring the peripheral velocity of the commutator or the core to a figure in excess of the usual 6000 to 8000 feet a minute. Doubling the shunt field current can be accomplished by halving the field circuit resistance. If the field coils are all in series, reconnecting them in two parallel paths will do. Sparkless commutation and avoidance of flashover, depending upon the type of armature winding, usually requires less than 25 volts between commutator segments if there are no interpoles.

To sum up, double voltage can be obtained, but design characteristics (including excess heating in the field coils) may make the plan ill advised. —L.E.B.

ANSWER TO V23—It should be practical to convert an old 200 hp 250 volt, 650 rpm motor to a 500 volt, 1200 rpm dc generator.

The age and condition of the motor

Time after time—the WINNER in *Competitive Bidding*

LPI *Luv-R-Lok*

EXCELS in shallow depth and flat bottom now so much in demand by owners.

PRICED attractively low for cost-minded buyers.

EXTREME EASE and speed of installation cut your labor costs, help keep your bids low, pay you good profits.

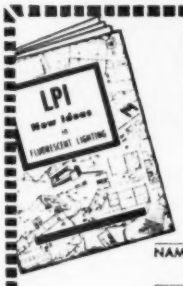
CLEANED at lower cost than any other fixture of equal size—a strong sales point.

YOU WILL WIN out oftener with LPI Luv-R-Lok.

LIGHTING PRODUCTS, INC.
HIGHLAND PARK, ILL.

REMOVABLE LOUVERS

Each louver blade, although locked *rigidly*, slips in and out with finger-tip ease. Quick wiping action cleans both sides simultaneously. Luv-R-Lok cleans in about one-tenth usual time. A new high in light output—a new low in maintenance cost.



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Lighting Products, Inc.
Dept. X, Highland Park, Illinois

Send me FREE copy of latest LPI Catalog, "*New Ideas in Fluorescent Lighting*," which contains full data and photos of the Luv-R-Lok and the complete LPI line.

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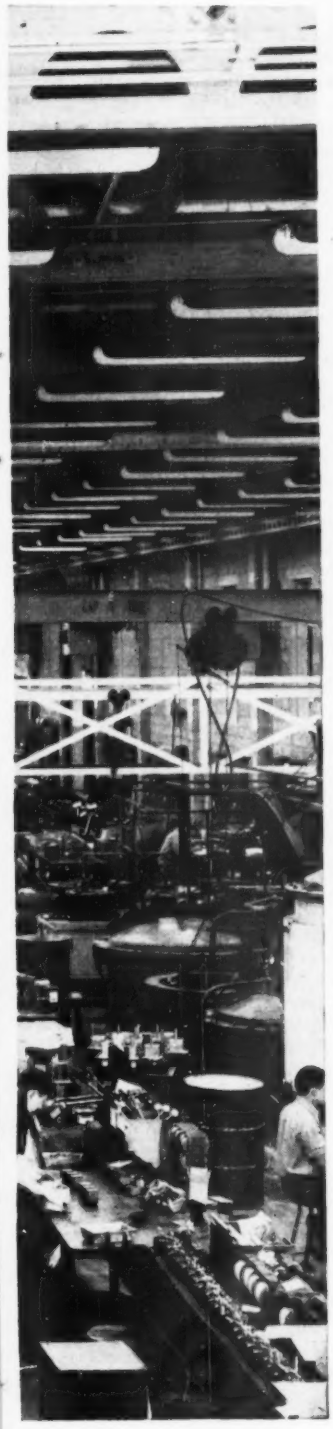

Here's how Westinghouse power centers increase plant output...safely

Safe, efficient power distribution that actually helps increase plant output... that's what this Western Pennsylvania manufacturer realized by installing modern Westinghouse dry-type power centers.

Dry-type power centers minimize installation costs because they are completely safe. Since they are *both* fire and explosion resistant, they can be located right in the production area. They require no vaults, catch basins, toxic gas vents, or drains. Lightweight, they can be installed overhead, releasing valuable floor space for production. This makes it easier to locate them close to the load they serve, shortening secondaries, cutting line losses, improving regulation. The result: Increased production efficiency.

In the plant pictured at the left, two Westinghouse power centers divide the load. Capacity is provided in each to allow for expansion.

Add these up for your plant: (1) Safe, economical installations. (2) Increased production space. (3) Increased plant efficiency through improved regulation. (4) Savings in power cost through reduced losses. (5) Savings in heavy copper through shortened secondaries.

Westinghouse power centers can bring these advantages to your plant, too. Because they are factory assembled and coordinated as one unit, with components designed to meet your individual requirements, they can be installed quickly and easily. For further information, check with your contractor, your Westinghouse distributor or local representative, or write direct to Westinghouse Electric Corp., P.O. Box 868, Pittsburgh 30, Pa.

J-70708

YOU CAN BE **SURE**...IF IT'S

Westinghouse

QUAD
GYMNASIUM
LIGHTING
UNITS

• Here is a specially designed unit combining lighting efficiency with the ability to withstand shocks and rough treatment. Flush mounted, this unit is ideal for installation in many types of modern construction where suspended ceilings are used.

The QUAD Gymnasium Lighting Unit has all of the features that make customers and profit. Installations have been made in various parts of the country, for combined gym and assembly halls, rinks, armories, and indoor arenas

It is serviced from above or below ceiling—has detachable porcelain enameled reflector—angle iron plaster ring—is adjustable for variable ceiling thicknesses—has heavy wire guard and a dust tight glass cover is optional.

QUADRANGLE MFG. CO.
32 S. PEORIA ST. CHICAGO 7, ILL.

will have to be considered. In general most dc motors should be satisfactory for operation at double speed and voltage, however the bar to bar commutator voltage, the condition of the armature windings and the banding wire should be considered.

If the motor is a straight shunt wound machine the shunt field should be satisfactory as is, as the excitation required as a generator at 500 volts, 1200 rpm will be roughly equivalent to the excitation as a 650 rpm motor at 250 volts. Should the voltage tend to be unstable at the higher speed due to operation on the straight portion of the field excitation curve, it could be stabilized by increasing the shunt field air gap by removing shims from behind the shunt field poles, thus requiring more field current, so that the machine would be operating above the knee of the excitation curve.

If the machine is compound wound, as a cumulative motor, series field bucking the shunt field for a flat speed characteristic, it may be necessary to either disconnect the series field, shunt the series field or to reconnect it for a cumulative generator, that is series field boosting the shunt field.—J.B.P.

Tandem Mounting Of Rheostats

QUESTION W23—We have many old rheostats lying around which are still in good condition. I want to connect these together in a tandem mounting to control the speed of a 5 hp, 220 volt slip ring motor. How do I determine the resistance and maximum current of the rheostat needed?—H. G. C.

ANSWER TO W23—The full load secondary current and the no load secondary voltage is marked on the nameplate. Watch that the resistance per phase should be equal, and be able to carry the load without overheating. Any number of steps is O.K. until you get the correct speed characteristics.—H. S.

Can you ANSWER these QUESTIONS?

QUESTION G24—We have a 15 hp, 230 volt dc compound motor with interpoles on which we had to use substitute brushholders. On test without load the motor ran fine and was easily reversed by reversing fields or armature current. However, when we connected it under load it would run

TRIANGLE *Presents* . . . IN HANDY WALL CHART FORM—
THE IMPORTANT 1953 CODE CHANGES
COVERING WIRE CABLE AND CONDUIT

ARTICLE 310—CONDUCTORS • SECTION 3102—CONDUCTOR INSULATIONS

TRADE NAME	TYPE LETTER Changes are in **BOLD**	Max. Operating Temp.	SPECIAL PROVISIONS
Rubber-Covered Fixture Wire Solid or 7 Strand	**RF-1**	60C 140F	Fixture wiring. Limited to 300 V.
	RF-2	60C 140F	Fixture wiring and as permitted in section 3103.
Rubber-Covered Fixture Wire Flexible Stranding	**FF-1**	60C 140F	Fixture wiring. Limited to 300 V.
	FF-2	60C 140F	Fixture wiring and as permitted in section 3103.
Heat-Resistant Rubber Covered Fixture Wire Solid or 7 Strand	**RFH-1**	75C 167F	Fixture wiring limited to 300 V.
	RFH-2	75C 167F	Fixture wiring and as permitted in section 3103.
Heat-Resistant Rubber-Covered Fixture Wire Flexible Stranding	**FFH-1**	75C 167F	Fixture wiring Limited to 300 V.
	FFH-2	75C 167F	Fixture wiring and as permitted in section 3103.
Thermoplastic-Covered Fixture Wire—Solid or Stranded	**TF**	60C 140F	Fixture wiring and as permitted in section 3103.
Thermoplastic-Covered Fixture Wire—Flexible Stranding	**TFF**	60C 140F	Fixture wiring.
Cotton-Covered Heat-Resistant, Fixture Wire	**CF**	90C 194F	Fixture wiring. Limited to 300 V.
Asbestos-Covered Heat-Resistant, Fixture Wire	**AF**	150C 302F	Fixture wiring. Limited to 300 V.
Code Rubber	**R**	60C 140F	General use.
Heat-Resistant Rubber	**RH**	75C 167F	General use.
Moisture-Resistant Rubber	**RW**	60C 140F	General use and wet locations.
Moisture and Heat-Resistant Rubber	**RH-RW**	60C 140F 75C 167F	General use and wet locations. General use.
Moisture and Heat-Resistant Rubber	**RHW**	75C 167F	General use and wet locations.
Latex Rubber	**RU**	60C 140F	General use.
Heat-Resistant Latex Rubber	**RUH**	75C	General use.
Moisture-Resistant Latex Rubber	**RUW**	60C 140F	General use and wet locations.
Thermoplastic	**T**	60C 140F	General use.
Moisture-Resistant Thermoplastic	**TW**	60C 140F	General use and wet locations.
Mineral Insulation (Metal Sheathed)	**MI**	85C 185F	General use and wet locations with Type O termination fittings. Maximum operating temperature for special applications 250C.
Thermoplastic and Asbestos	**TA**	90C 194F	Switchboard wiring only.
Varnished Cambric	**V**	85C 185F	Dry locations only. Smaller than No. 6 by special permission.
Asbestos and Varnished Cambric	**AVA**	110C 230F	Dry locations only.
Asbestos and Varnished Cambric	**AVL**	110C 230F	Wet locations.
Asbestos and Varnished Cambric	**AVB**	90C 194F	Dry locations only.
Asbestos	**A**	200C 392F	Dry locations only. Not for general use. In raceways, only for leads to or within apparatus. Limited to 300 V.
Asbestos	**AA**	200C 392F	Dry locations only. Open wiring. Not for general use. In raceways, only for leads to or within apparatus. Limited to 300 V.
Asbestos	**AI**	125C 257F	Dry locations only. Not for general use. In raceways, only for leads to or within apparatus. Limited to 300 V.
Asbestos	**AIA**	125C 257F	Dry locations only. Open wiring. Not for general use. In raceways, only for leads to or within apparatus.
Paper		85C 185F	For underground service conductors, or by special permission.
Slow-Burning	**SB**	90C 194F	Dry locations only. Open wiring; and in raceways where temperatures will exceed those permitted for rubber-covered or varnished cambric-covered conductors.
Slow-Burning Weatherproof	**SBW**	90C 194F	Dry locations only. Open wiring only.
Weatherproof	**WP**	80C 176F	Open wiring by special permission where other insulations are not suitable for existing conditions.

NOTE: The significance of the above changes is as follows:

1. The addition of four new designs of fixture wire — **RFH-1, RFH-2, FFH-1, FFH-2,** all of which have a maximum operating temperature of 75C. These new designs narrow the gap which now exists between the 60C fixture wire and the 90C heat resisting fixture wire. Several applications are open for the use of these new 75C insulations.

2. The old Type letter designations, RF64 and RF32 as well as FF64 and FF32 have been replaced as shown.

3. The old Type letter designations, RUF and RUFF have been deleted. They are now covered under the general designations for rubber insulation.

4. A new Type letter, **RUH,** heat resistant latex rubber, has been added.

5. Two more new Types, **RH-RW** and **RHW** have been added. Type **RH-RW** is a combination heat and moisture resistant insulation recognized for use in a wet location, at a maximum operating temperature of 60C, 140F. It is also recognized for general use at 75C—167F. This means that a #1 Type **RH-RW** insulated conductor would have a current carrying capacity of 110 amperes when used in a wet location and 130 amperes when used generally. This is covered by a new note, 4a, following Tables 1 and 2, Chapter 10.

Type **RHW** is a 75C insulation and will therefore have a current carrying capacity as shown in column 3 of Tables 1 and 2, Chapter 10, irrespective of use in a wet location or general use.

For a larger version of this Chart, write Triangle Conduit & Cable Co., New Brunswick, New Jersey.

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ADDITIONAL REVISIONS IN THE NATIONAL ELECTRICAL CODE WHICH PARTICULARLY CONCERN CONDUCTORS, CABLE ASSEMBLIES AND CONDUIT OR TUBING

SECTION 2112. COLOR CODE. BRANCH CIRCUITS. Add a new paragraph as follows: "Any conductor intended solely for grounding purposes shall be identified by a green color unless it be bare. Conductors having a green covering shall not be used for other than grounding purposes."

SECTION 2203 a. GENERAL LIGHTING, SCHOOL BUILDINGS. Table B which covers the demand factors for various types of occupancy has been changed to eliminate any demand factor in a school building. The total wattage, 100% demand, must be used in figuring such feeders.

COMMENT: The Panel feels that present day illumination practices and loading demands in a school occupancy do not justify less than 100% of the unit loads in Column A.

SECTION 2203 a. GENERAL. Under the Table a change has been made for Office Buildings. At the present time such occupancies have a unit load per sq. ft. of 2 watts. This has been increased to 3 watts. The 20,000 watt load now subject to a 100% demand factor has been increased to 30,000 watts.

COMMENT: The Panel feels that the increased levels of illumination, air conditioning, etc., in modern construction justify this increase in feeder sizes.

SECTION 2303 a. UNINSULATED NEUTRAL. This section has been changed to read as follows:

"In the case of Service Conductors that have a nominal voltage to ground of not more than 300 volts, a grounded service conductor without an insulating covering may be installed."

COMMENT: The Panel is of the opinion that the change will encourage more "inter-connected grounding" which will improve protection.

SECTION 2311. MECHANICAL PROTECTION (UNDERGROUND SERVICES). The new provision reads as follows:

"Underground service conductors shall be protected against mechanical injury by being installed in duct, conduit, in cable of one or more conductors approved for the purpose, or by other approved means. See Section 3102 b."

COMMENT: It is now clear that a one conductor assembly is considered a cable.

SECTION 2574. VOLTAGES. BONDING. EXCEEDING 250 VOLTS. THIS WILL BE RENUMBERED SECTION 2575. This Section has been reworded so that service entrance conductors are eliminated and the voltage is changed from 150 to 250 volts.

COMMENTS: The principal reason for the change concerns the three phase, 4 wire-delta connection which results in 240 volt, 3 phase current for power and single phase 120-240 volt current for lighting. The highest voltage to ground on such a combination is 208 volts on one phase wire only; the other two phases operate at 120 volts to ground. While the original objective was to increase the voltage only to 208 volts and thus clear up the confusion which has arisen on 3 phase, 4 wire delta systems, the Panel members have decided to raise the voltage to 250 volts.

SECTION 2592 b. INSTALLATION. (GROUNDING CONDUCTORS) This is a new provision which reads as follows:

"2592 b CONDUCTOR ENCLOSURES AND EQUIPMENT ONLY. A grounding conductor for conductor enclosures and equipment only shall meet the requirements of Section 2592 a, except that where smaller than No. 6, as permitted by Section 2595, it need not be armored or installed in a raceway if run through the hollow spaces of a wall or partition or otherwise run so as to be not subject to mechanical injury."

COMMENT: The continued promotion of the use of grounding conductors in cable assemblies should minimize the use of alternate methods of grounding enclosures and equipment.

SECTION 3018. ALTERNATING CURRENT SYSTEMS IN METAL ENCLOSURES. Change last sentence of this section to read as follows:

"If the capacity of a circuit is such that it is impracticable to run all conductors in one enclosure, the circuit may be divided and two or more enclosures may be used providing each phase conductor of the circuit and the neutral conductor, if one is used, are installed in each enclosure. The conductors of such an installation can conform to the provisions of Sections 3105 for multiple conductors."

SECTION 3105. CONDUCTORS IN MULTIPLE.
"Conductors in sizes 1/0 to 500,000 c.m., inclusive, may be run in multiple provided they are of the same length and have the same circular mil area and type of insulation. When conductors are run in multiple, they shall be arranged and terminate at both ends in such a manner as to insure equal division of the total current between all conductors that are involved."

COMMENT: The second and third sentences of the present text have been deleted. They read as follows: "Not more than three No. 1/0, four No. 2/0, nor five Nos. 3/0 to 500,000 c.m. conductors, may be run in multiple. Except as herein provided, conductors shall be run in multiple only by special permission or as permitted in Section 6205."

It is common practice to use as many conductors as may be necessary and experience has not yet indicated the necessity for limitations in numbers now imposed.

ARTICLE 334 — ARMORED CABLE

SECTION 3342. USE. The present provisions under Section 3342 indicate that Type ACV cable is limited in size to No. 4 and larger. The new wording makes an exception when ACV cables are approved for use at over 600 volts. No minimum wire size is specified.

The fourth sentence has been changed. The new provision recognizes Armored Cable for use in the air voids of any type of masonry block if they are not below grade line and otherwise not exposed to excessive moisture or dampness.

ARTICLE 330. NON-METALLIC SHEATHED CABLE.

SECTION 3362. USE. This Section has been rewritten to provide for two types of cable as follows:

a.—Type NM—This type of cable is suitable for use for general wiring in normally dry locations and in the hollow spaces of masonry walls where not subject to excessive moisture or dampness.

b.—Type NMC—We now have special recognition and extended use for the thermoplastic and neoprene jacketed cables which are considered suitable for use in corrosive locations and dry, moist or damp locations, including inside and exterior masonry block walls, above or below grade line, where excessive moisture may occur periodically. This type of cable is not permitted in wet locations as defined in Article 100, however, it is not intended to prohibit the use of the new type UF cable covered by Article 339, when used for interior wiring under Article 336, in such wet locations. Type NMC cable may be embedded in plaster or run in a shallow chase in masonry walls and covered with plaster within 2 inches of the finished surface provided it is protected against damage from nails by a cover of corrosion-resistant coated steel at least $\frac{1}{16}$ inch in thickness and $\frac{3}{4}$ inch wide in the chase or under the final surface above or below grade lines.

c. — USES NOT PERMISSIBLE FOR EITHER TYPE NM OR NMC NON-METALLIC SHEATHED CABLE. These types shall not be used as (1) Service-entrance cable, (2) in commercial garages, (3) in theatres except as provided in Section 5211, (4) in motion picture studios, (5) in storage battery rooms, (6) in hoistways, (7) in any hazardous location, (8) embedded in poured cement, concrete or aggregate.

ARTICLE 339. UNDERGROUND FEEDER AND BRANCH CIRCUIT CABLE TYPE UF.

3391. SCOPE. Installations of underground feeder and branch circuit cable (Type UF) shall comply with the provisions of Section 3001 and 3020 inclusive, paragraph b of Section 3102, and in addition shall conform with provisions of Section 3392.

3392. USE. Underground feeder and branch circuit cable may be used underground, including direct burial in the earth, as feeder or branch circuit cable when provided with overcurrent protection not in excess of the rated current carrying capacity of the individual conductors. If single conductor cables are installed, all cables of the feeder circuit, sub-feeder circuit or branch circuit, including the neutral conductor, if any, shall be run together in the same trench or raceway. If buried directly in the earth, supplementary mechanical protection, such as a covering board, concrete pad, raceway, etc., when considered necessary, may be required by the authority enforcing the Code. Multiple Conductor, Type UF cable may also be used for interior wiring when complying with the provisions of Article 336 and may be used in wet locations.

COMMENT: This is a new Code Article which extends the recognition of the use of cables for direct burial in the ground from that now recognized for service use, Type USE, to Type UF. (feeders and branch circuits only)

ARTICLE 346 — RIGID METAL CONDUIT

ARTICLE 348 — ELECTRICAL METALLIC TUBING

SECTION 3464. WET LOCATIONS. A new paragraph has been added which reads as follows: "All supports, bolts, straps, screws, etc., shall be of corrosive-resistant materials or protected against corrosion by approved corrosion-resistant materials."

The same provision also applies to Electrical Metallic Tubing used in wet locations. (Section 3484)

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only in one direction and we could not reverse it as we did under test. After experimenting we found that after we shifted the brushholders we could reverse it. Could someone explain why the motor could not be reversed before shifting brushholders?—S.R.U.

QUESTION H24—I have had the experience of having a ¾ hp, 110-220 volt, single phase, capacitor, 3450 RPM motor destroy its centrifugal switch. Not having any replacement parts, and no other harm done, I replaced the centrifugal switch with a toggle switch so the motor could be used.

This proved satisfactory as far as using the motor, but one thing puzzled me. When I opened the line switch and a few seconds later closed the start toggle switch, the motor slowed down in speed, but not to a complete and sudden stop. I would like an explanation for this.—W.R.B.

QUESTION J24—To return to the subject of whether a fluorescent starter can be of somewhat different rating than the bulb it operates, and still be dependable, has anyone run into the circular fixtures where two sizes of bulbs are controlled by one starter?

If I use a starter small enough so that the small bulb will always start, the large bulb will fail once in a while. Also the small one will occasionally fail if I use a starter large enough for the large bulb.

The only thing I can see to do is install another starter and starter socket, but is there any better method?—M.C.T.

QUESTION K24—In the section where I live and work we are confronted with a problem. The four wire-three phase WYE connected service system is coming into general use, and nowhere in any of my text books can I find a mathematical formula for determining the load on the neutral conductor of an unbalanced lighting panel?—L.E.H.

QUESTION L24—We have a single phase motor which needs to be rewound, but we find it uses aluminum wire. Can we rewind this motor with copper wire? Would you use the same size wire and the same number of turns as were used with the aluminum wire?—R.E.G.

QUESTION M24—Will a stronger commutating field take the place of a stronger series fields?—H.S.

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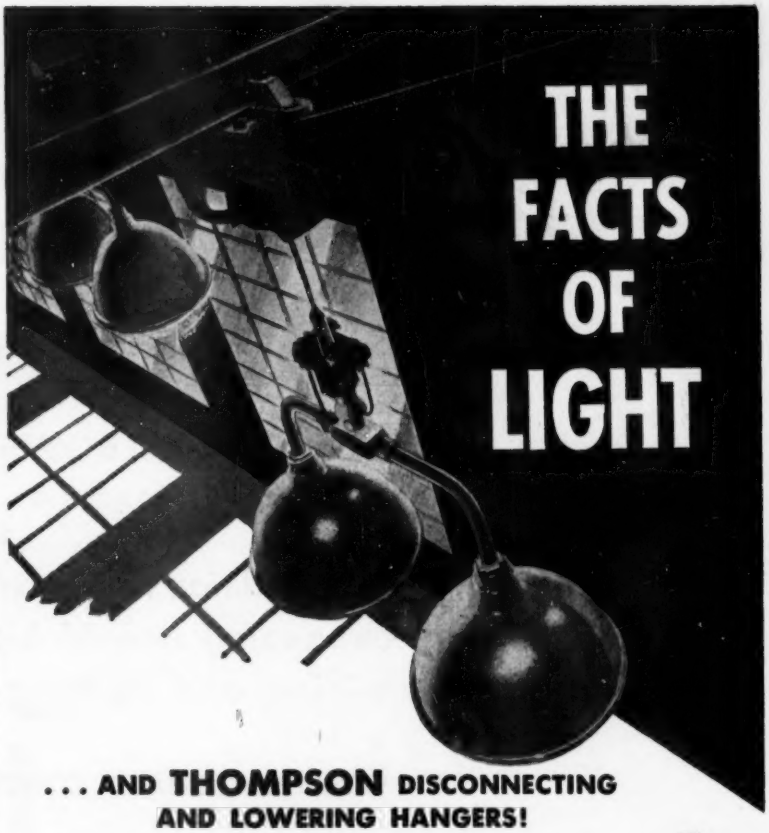

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Answered by

B. A. McDONALD, *New York Board of Fire Underwriters, Rochester, N. Y.*
GLENN ROWELL, *Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.*
B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*

Multi-Family Services And Feeders

Q. *A multi-family dwelling, consisting of four apartments has a total floor area of 2704 sq. ft. divided as follows; two apartments have a floor area of 572 sq. ft. each and two are two story apartments with a floor area of 780 sq. ft. each. The service is three wire, single phase, 115-230 volts, and a 3 wire, 115 volt-230 volt feeder supplies each apartment. There are no special loads such as ranges or water heaters. Each apartment is separately metered and has its own service equipment which is located on the outside wall of the building. The service equipment for all four apartments are grouped at one point and are supplied through one set of service entrance conductors. What is the minimum size of service entrance conductors and feeders to each apartment recognized by the N. E. Code for such an installation? If a 12 kw range was installed in each apartment, what is the minimum size service and feeder to each apartment required by the Code?—O.P.G.*

A. In order to clarify my answer, I have shown by illustration No. 1, the apartments involved, their sq. ft. areas and the total load of each computed in line with Section 2203 of the Code. Reference to the illustration shows that the total load for each apartment is 15 amps for two and 14 amps for the other two. It therefore appears that the 3 wire feeder to each apartment could be No. 14 wire. This however is not correct since Section 2201 of the Code requires a minimum No. 10-3 wire feeder when it serves more than 2-two wire branch circuits. Assuming that there are more than 2 circuits per apartment, the minimum size feeder to each apartment would be No. 10.

Computations covering the size of the service entrance conductors serving all four apartments are also shown on this illustration. According to the Code and the demand factors recognized by Section 2203, the total load would be 30 amps. Here again, it appears that 3-No. 10 conductors would be large enough but Section 2304 of the Code calls for a minimum No. 6 when there are more than 2-two wire branch circuits. It therefore follows that the minimum size of the service entrance conductors, supplying all 4 apartments, would be No. 6.

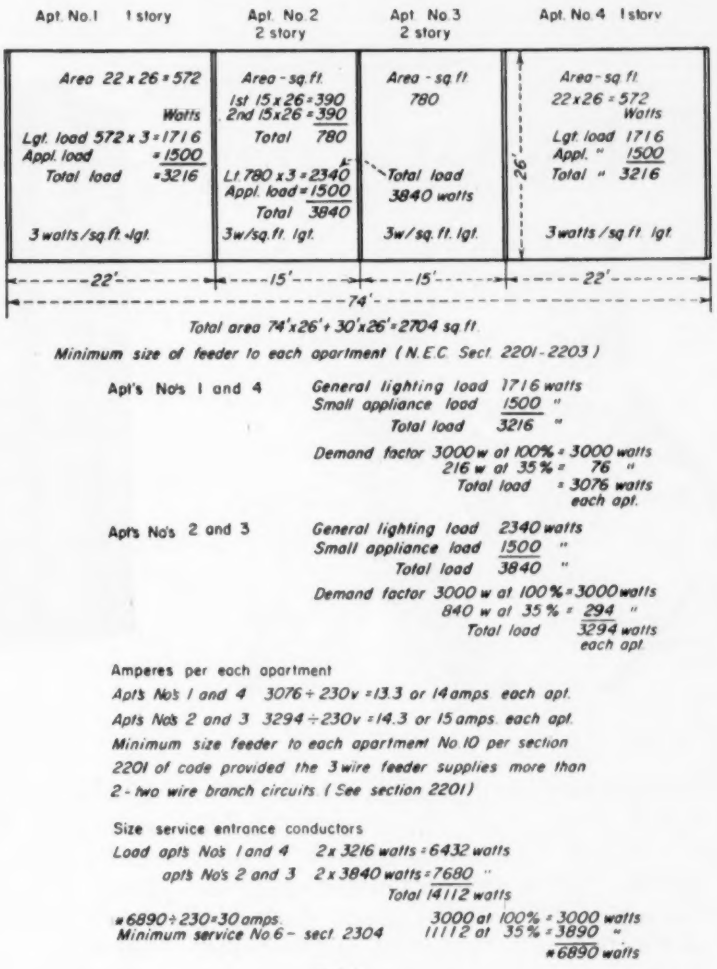
Apt. No.1 1 story
Apt. No.2 2 story
Apt. No.3 2 story
Apt. No.4 1 story
Area 22 x 26 = 572
Watts
Lgt. load 572 x 3 = 1716
Appl. load = 1500
Total load = 3216
3 watts/sq.ft. lgt.
Area - sq.ft.
1st 15 x 26 = 390
2nd 15 x 26 = 390
Total 780
Lt. 780 x 3 = 2340
Appl. load = 1500
Total 3840
3w/sq.ft. lgt.
Area - sq.ft.
780
Total load
3840 watts
3w/sq.ft. lgt.
Area - sq.ft.
22 x 26 = 572
Watts
Lgt. load 1716
Appl. " 1500
Total " 3216
3 watts/sq.ft. lgt
26'
22'
15'
15'
22'
74'
Total area 74'x26' + 30'x26' = 2704 sq.ft.
Minimum size of feeder to each apartment (N.E.C. Sect. 2201-2203)
Apt's Nos 1 and 4
General lighting load 1716 watts
Small appliance load 1500 "
Total load 3216 "
Demand factor 3000 w at 100% = 3000 watts
216 w at 35% = 76 "
Total load = 3076 watts each apt.
Apt's Nos 2 and 3
General lighting load 2340 watts
Small appliance load 1500 "
Total load 3840 "
Demand factor 3000 w at 100% = 3000 watts
840 w at 35% = 294 "
Total load 3294 watts each apt.
Amperes per each apartment
Apt's Nos 1 and 4 3076 ÷ 230v = 13.3 or 14 amps. each apt.
Apts Nos 2 and 3 3294 ÷ 230v = 14.3 or 15 amps. each apt.
Minimum size feeder to each apartment No 10 per section 2201 of code provided the 3 wire feeder supplies more than 2 - two wire branch circuits (See section 2201)
Size service entrance conductors
Load apts Nos 1 and 4 2 x 3216 watts = 6432 watts
apts Nos 2 and 3 2 x 3840 watts = 7680 "
Total 14112 watts
= 6890 ÷ 230 = 30 amps.
Minimum service No 6 - sect 2304
3000 at 100% = 3000 watts
11112 at 35% = 3890 "
= 6890 watts

FIG. 1

In order to avoid any misunderstanding of the layout, I am showing by illustration No. 2 the service installation on the outside wall of the building as I understand it. This illustration shows the individual meters and service equipment for each apartment and also the No. 10 feeders running to the branch circuit fuse or circuit breaker panels located in each apartment. I have shown a 60 amp switch or a 50 amp circuit breaker as the main means of disconnect and overcurrent protection for the feeders to each apartment. Here again, it appears that a 30 amp switch or circuit breaker would be sufficient but Section 2357 of the Code requires the larger size switch or breaker provided there are more than 2-two wire branch circuits supplied. It also follows however that the No. 10 feeder conductors must be properly protected and if 60 amp switches are used the proper fuse to use would be 35 amps.

Since this service equipment will be exposed to the weather, unless suitably enclosed, it must be approved

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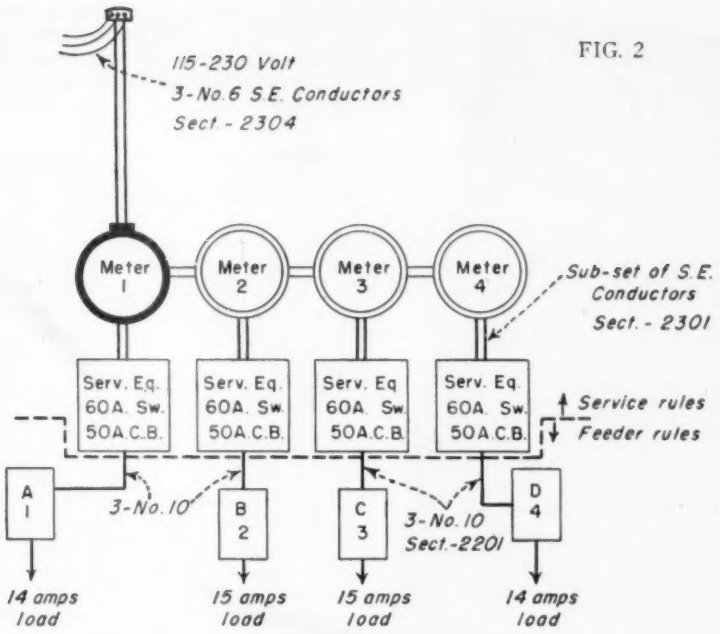


FIG. 2

A-B-C-D: Branch circuit panels in each apartment.
Service equipment outside the building wall. 2351-A.-B.

Serv. Equip. 2351-A 2371-A
1. *Must be approved for Service use.*
2. *Must be readily accessible*
3. *Must be approved for outside exposure*

for such exposure and also accessible to each occupant, Section 2351-b. If however, the service equipment is locked or sealed, the branch circuit overcurrent devices shall be mounted in an accessible location and of a rating lower than the service overcurrent device. See Section 2373.

Other arrangements for the outside meter and service equipment could be made to satisfy the types of equipment.

If a 12 kw range was installed in each apartment, the feeder to each apartment must be increased in size to serve an additional 8000 watts. A 12 kw range, according to Col. A-Table 29 has a demand of 8000 watts. If this amount is added to the wattage already calculated for lights and small appliances, we would obtain the following:

3294 watts + 8000 watts = 11,297 watts.

11,297 — 230 volts = 49 amps.

As a result the feeders to each apartment must be increased to No. 6 to properly satisfy this additional load.

The service would be increased as shown:

6,890 watts. — Lgt's and Appl's — 4 Apts.

17,000 watts. — 4-12 KW ranges — Table 29.

23,890 + 230 Volts = 104 Amps.

This load would require No. 2-R H or No. 1-R conductors.—B.A.McD.

Line Currents—Delta Loading

Q. *Would you be kind enough to comment as to which figures are more nearly accurate for the loading of the delta circuit shown by the illustration?*

Will A¹ Read 27.32 Amps
Will A² Read 13.66 Amps
Will A³ Read 23.66 Amps
OR
Will A¹ read more nearly 26.5 Amps

Fig. No. 1

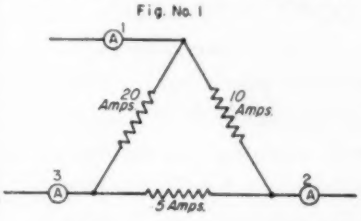
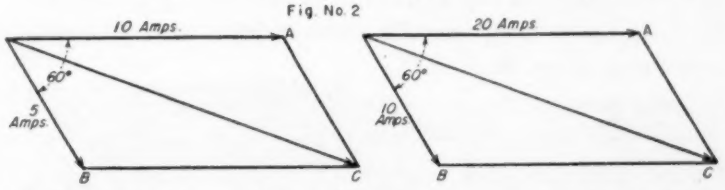


Fig. No. 2



$C^2 = A^2 + B^2 + 2AC \cos 60°$
$C^2 = 100 + 25 + 2 \times 10 \times 5 \cos 60°$
$C^2 = 125 + 50 = 175$
$C = \sqrt{175} = 13.229$ Amps.
$\cos 60° = .5$
Current in A-2 = 13.229 Amps.

$C^2 = 400 + 100 + 2 \times 20 \times 10 \cos 60°$
$C^2 = 500 + 200 = 700$
$C = \sqrt{700} = 26.457$ Amps
Current in A-1 = 26.457 Amps.

Current in A-3 Same equation applies
$C^2 = 20^2 + 5^2 + 2 \times 20 \times 5 \cos 60°$
$C^2 = 400 + 25 + 100 = 525$
$C = \sqrt{525} = 22.92$ Amps
Current in A-3 = 22.92 Amps.

Will A¹ read more nearly 13.45 Amps
Will A³ read more nearly 22.80 Amps
—P.P.G.

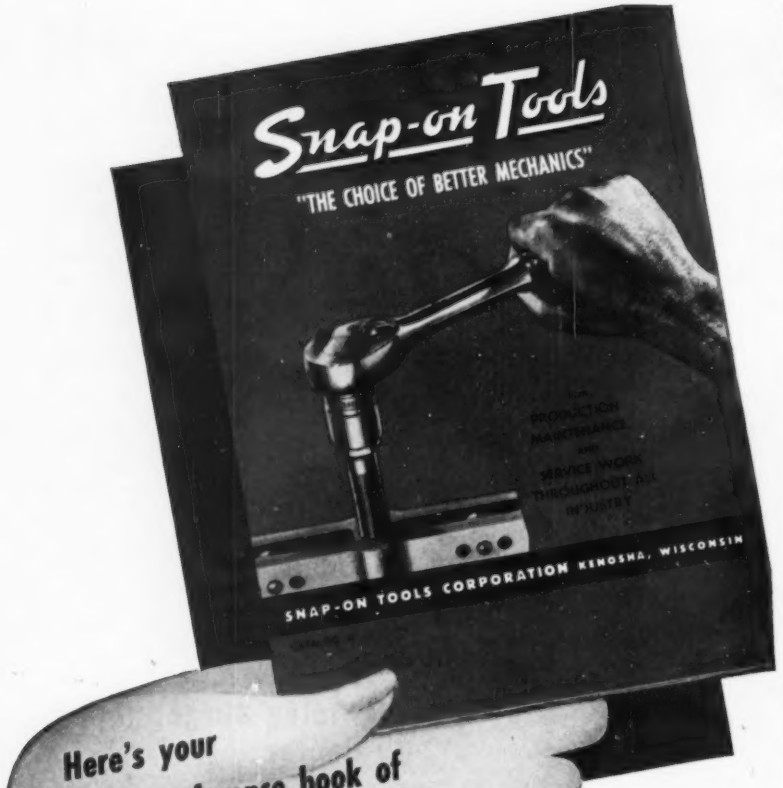
A. Assuming the power factor of the loads are equal, it appears to me that the second group of figures are more accurate. In support of this conclusion, I am showing in Fig. No. 2 the method used in computing the various line currents when the three phases are loaded as shown. The current through the ammeter in leg 1 would be the vector sum of 20 and 10 amperes which according to the formula results in the square root of 700. The current in Line 2 is the vector sum of 10 and 5 amperes and is shown to be the square root of 175. The current in Line 3 is the vector sum of 20 and 5 amperes and is shown to be the square root of 525. As a result, I find the currents in the various line wires to be as follows: A¹—26.457 Amps. A²—13.229 Amps. A³—22.92 Amps.—B.A.McD.

Lightning Surge Protector

Q. *Does the Code require the use of a lightning surge protector at the weather-head of a suburban dwelling?*—E.E.T.

A. The National Electrical Code does not as yet require lightning surge protection at the service to a suburban dwelling. However, there are some REA's and other utility properties who are recommending the use of the new surge protectors as made by the Joslyn Manufacturing Company or the General Electric Company in the drip loop at the service head to isolated suburban properties in those areas where lightning frequency is such that protection of this type is justifiable. So far I personally know of only one supplying utility which makes such an installation mandatory on all buildings served by them.

Regardless of whether or not the Code requires such protection, it would



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seem an excellent safeguard for use in all isolated areas where lightning frequency is similar to that found in the upper midwest section of this country.—G.R.

Insulated Bushings

Q. *I would appreciate it very much if you would clarify the proper application or interpretation of Article 373, Section 3736, Paragraph b, of the NEC which requires the use of insulated bushings where ungrounded conductors of No. 4 or larger enter a raceway.*

The following are the specific questions I would like to be answered in this connection:

1. Is the application of this rule mandatory for all cases as far as type of insulation used or relative position of cables entering and leaving the cabinet?

2. Could there be an exception to this requirement if type RR-600 volt cable is used? In the particular case under consideration type RR-600 volt cable emerge vertically from underground. Cables are then bent in a fairly long radius so that the pressure of the standard bushing against the insulation is not, in our opinion, enough to cause damage to the insulation. This is particularly true when these cables are protected by an exterior neoprene jacket which is supposed to withstand some mechanical injury without being damaged.

3. If the use of this insulated bushing is a requirement for all cases why is the manufacture and use of the standard type of bushing without insulating liners so universal?

Your prompt answer to these questions will be greatly appreciated as it will be used to settle an issue brought forth by the inspector in one of our housing projects.—J.E.B.

A. Question No. 1. It is my opinion that this Code provision applies to the different types of insulation recognized for wiring methods as outlined in Article 310 regardless of the degree of deflection involved. The 1946 Code only applied when the conductors were deflected 30 degrees or more.

Question No. 2. I do not believe or agree that any exception should be made for Type RR-600 volt insulation regardless of the absence of any deflection where the conductors enter the enclosure. If, however, the conductors are a part of a cable assembly approved for use without raceway protection, I am inclined to believe that the rule does not apply. The rule, in

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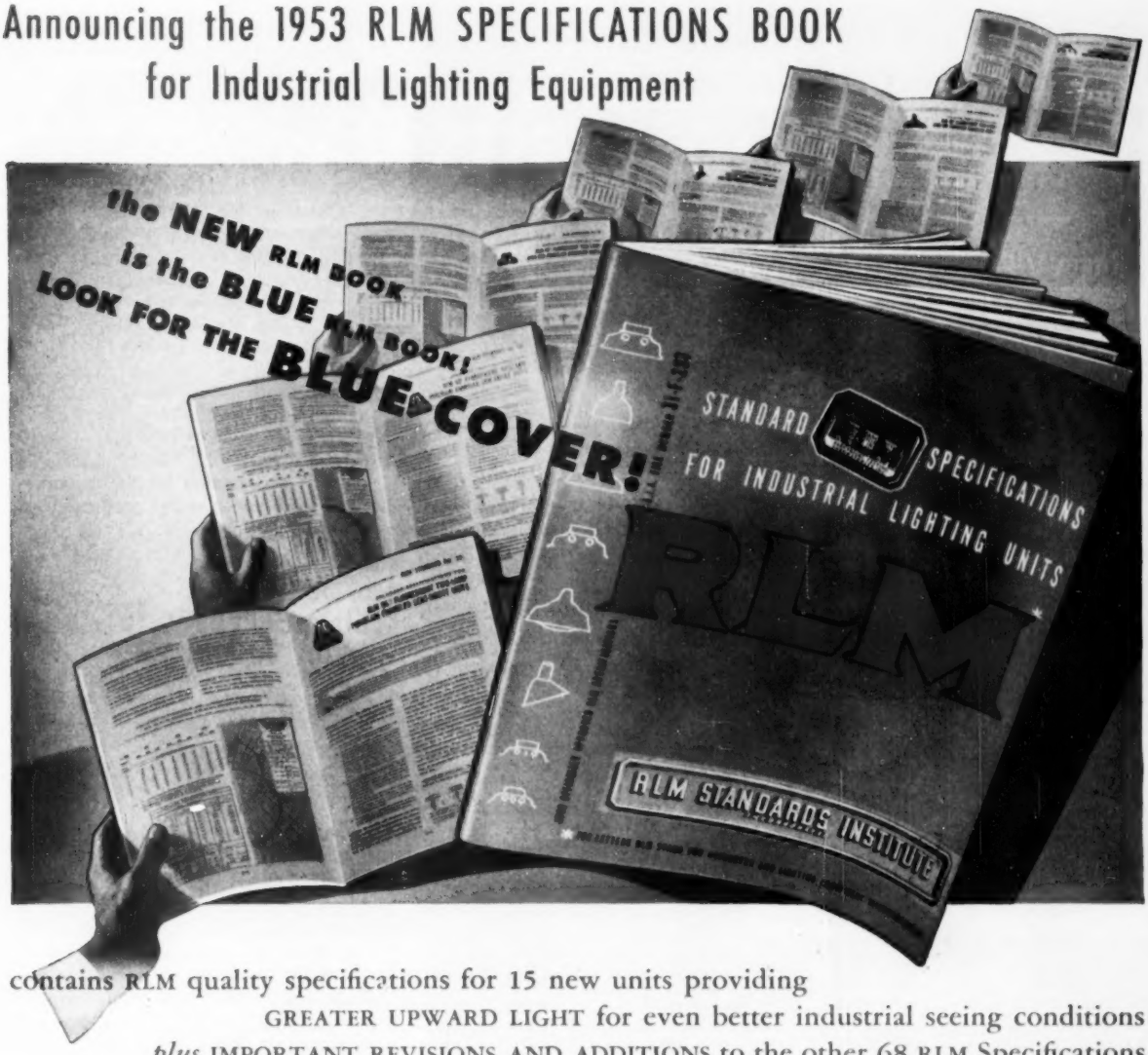

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my opinion, applies to conductors and not cables. I personally believe the rule is justified in view of past field experiences which proves that conductors that are not deflected fail where they rest on metal bushings due possibly to their own weight and vibration.

Question No. 3. Section 3736-b recognizes in addition to the insulated bushings, sleeves of substantial insulating material securely fastened in place. Two manufacturers have listed by Underwriters' Laboratories fiber bushings specially approved for such use. They are of split sleeve construction and can be inserted in the end of a conduit where a metal bushing is used. Since the rule may be satisfied by the use of such insulating sleeves, there is no occasion for the manufacturer to discontinue the production of all metal bushings.—B.A.McD.

Eleven Type T In ½ in. Conduit

Q. *Is there any provision in the 1951 Code that would permit 11 No. 14 solid, type T conductors to be pulled into a ½ in. existing conduit? It is assumed that the conduit could not be enlarged.—M.H.*

A. Table No. 4 of the Code limits the number of wires in a conduit to 9, with an exception which is covered by Table No. 9. This Table only applies to special applications such as conductors between a motor and its controller; stage pocket and border circuits, Section 5212 etc, as covered by fine print note following Table No. 9. So far, none of these Tables would permit 11 No. 14, Type T conductors in a ½ in. conduit.

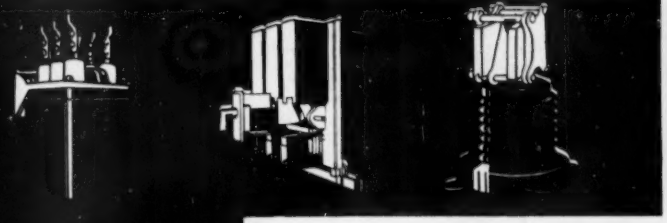
Table No. 11 however permits a 50% conduit fill for more than two conductors in a raceway for the sole purpose of rewiring existing raceways for increased load where it is impracticable to increase the size of the raceway due to structural conditions. Official Interpretation No. 286, issued Feb. 14, 1947 helps to clarify the intent of this provision. It reads as follows:

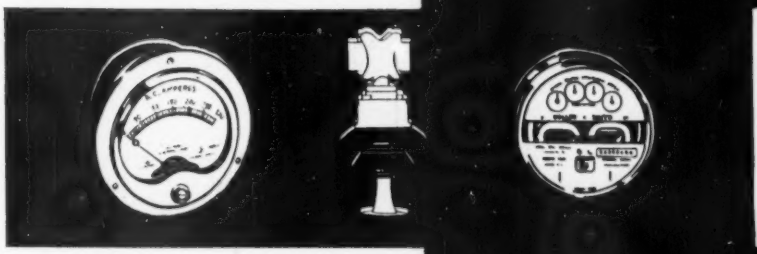
QUESTION: *Is it the intent of Table 11–1947 edition of the N. E. Code to permit rewiring in existing exposed raceways where it might be necessary to enlarge holes through floors, walls etc., and thereby disfigure the finish of buildings to install larger size raceways?*

ANSWER: No, it is intended that this provision apply to concealed raceways.

If you find that your application

MAKING





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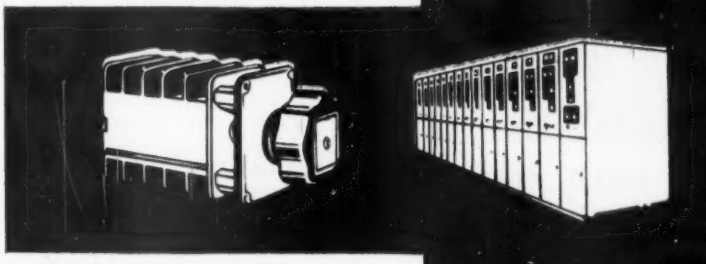

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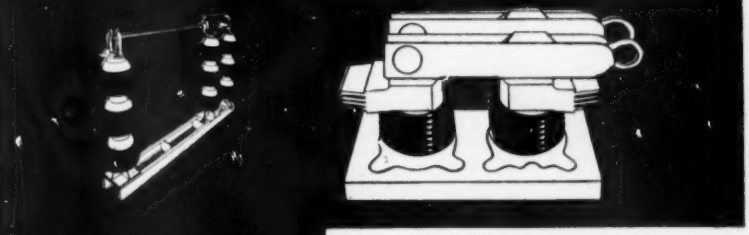

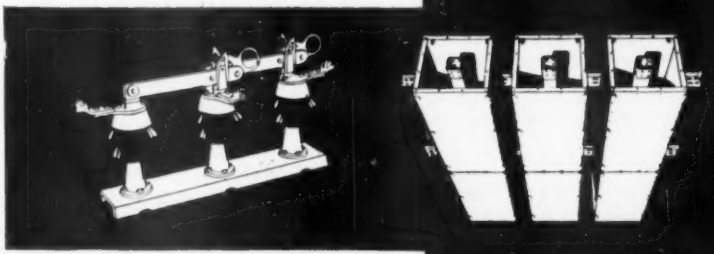

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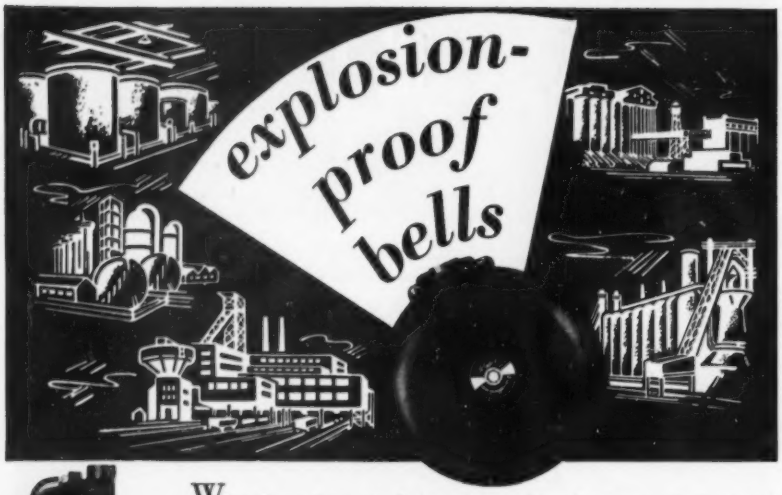

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fully meets the foregoing provisions, you may fill a ½ in. conduit with No. 14, Type T conductors to 50% of its square inch area. For example, Table 13 shows the area of a Type T, No. 14 conductor to be .0135 and Table No. 19 shows the area of a ½ in. conduit to be .30 sq. inches. 50% of .30 is .15 sq. ins. The total area occupied by 11 No. 14, T conductors would be 11 x .0135 = .1485 sq. ins. Since this last figure is less than 50% of the area of the conduit, 11 No. 14, T conductors could be installed in a ½ in. conduit; provided your application qualifies for the use of Table No. 11.—B.A.McD.

Feeder Disconnects

Q. *Condition: A manufacturing plant comprised of several buildings all of which are physically connected together or are accessible to one another by tunnel and are under one management.*

This plant has its own generating plant, maintaining qualified operating personnel on duty 24 hours per day, 365 days per year.

A sprinkler alarm system connected to each building is terminated at a point within the generating room where a bell is sounded whenever there is an indicated flow of water in the sprinkler system of any building.

All buildings have feeders running to them. These feeders emanate from a modern switchboard, each one protected by an air or oil circuit breaker. Voltage on these feeders is 440 volts.

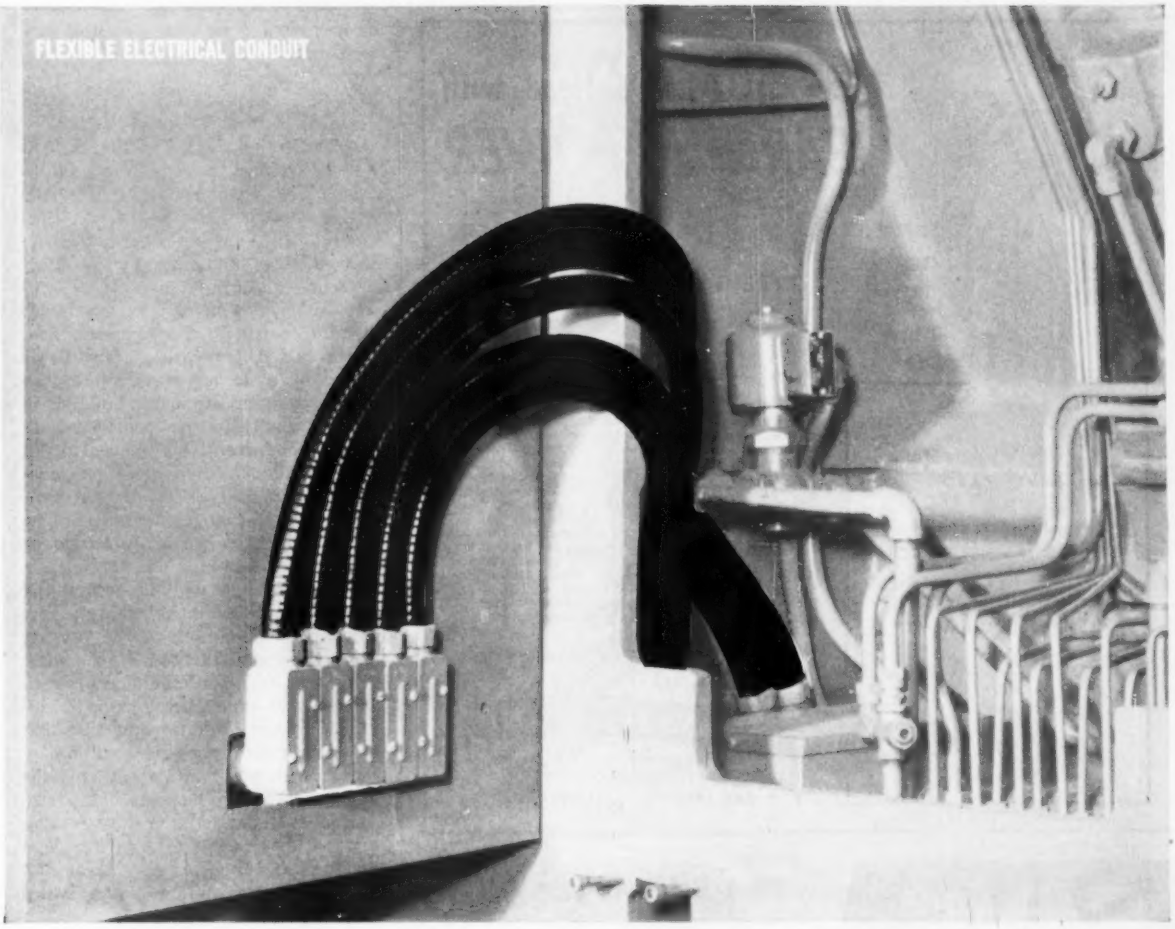
A feeder is to be installed from the main switchboard (properly protected by an ACB or OCB at this point) to a building remote from the generating room through buildings or tunnels or a combination.

A power distribution panel to be fed by this feeder is located on the 6th floor of the building.

Would it be permissible to run this feeder continuous from the switchboard to the distribution panel without installing a disconnecting means where the feeder enters the building? The feeder will be terminated in a switch and the power panel will be connected to the load side of the disconnecting switch.

Section 2351 of the 1951 code, paragraph "d", states, "The conductors supplying each building served shall be provided with a readily accessible means, within or adjacent to the building, of disconnecting all ungrounded conductors from the source of supply".

Question: Would the above code requirements be satisfied under the condition that the switchboard in the generating room is under constant supervision and the feeder could be



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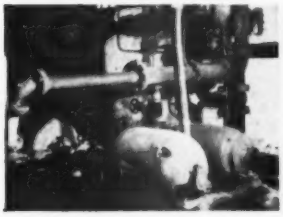

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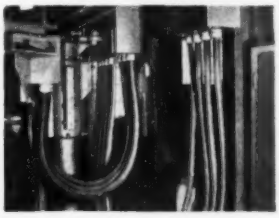

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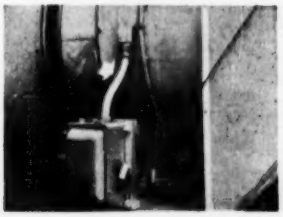

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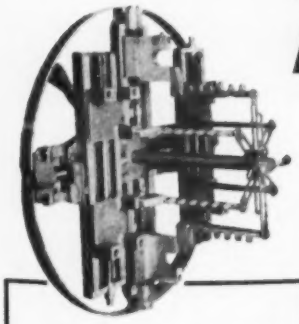

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de-energized from that point in case of necessity at any time of day or night, every day in the year?—M.N.C.

A. Section 2351-d of the Code is satisfied under the conditions covered by your question. This rule was reworded in the 1946 Code. Previous to 1946 the rule, under Section 2306, read as follows:

"2306—Master Services. In a property comprising more than one building under single management, and which has a generating plant or is served by a master service, the conductors running from one building to another shall not be considered as service conductors; but the wiring in each building served shall be separately controlled and properly protected by overcurrent devices. The control should be a circuit-breaker or an enclosed externally-operable switch, which may be located in the building served or in another building, provided it is accessible to the persons using the installation. Fine print note. "Garages and Outbuildings of residences come under this section."

The present Code wording says that the disconnecting means shall be located within or adjacent to the building served. The use of the term "adjacent" was the source of controversy with respect to the intent. As a result official interpretation No. 313, which reads as follows, was issued December 10, 1948:

"Q. Disconnecting means in Residential Garage.

"With respect to a garage, is it necessary to construe the term "adjacent to the building" of paragraph d of Section 2351 so as to prevent placing the disconnecting means at the house instead of at a detached garage on the same premises?

"Finding: No, the intent was to follow the practice specified in the 1940 edition of the Code."

While this interpretation specifically refers to a garage on residential property, the answer by the nature of the wording infers that there was no intention to alter the requirements as covered in 1940. As a result, it is my opinion that the feeder you describe is properly controlled and protected by the breaker at the main switchboard. I also believe that under the conditions described, switchboards in such installations are under supervision and the feeder could be readily disconnected if necessary. The Code covers this point in a general manner when it says that the disconnect must be readliy accessible.—B.A.McD.

SEE SPECIAL REPORT ON CODE REVISIONS—Page 87

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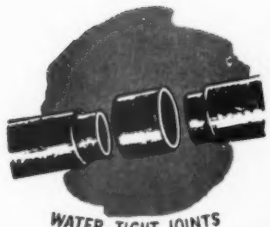
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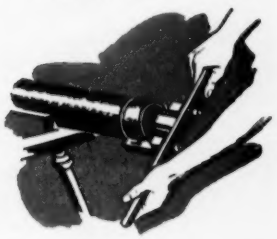
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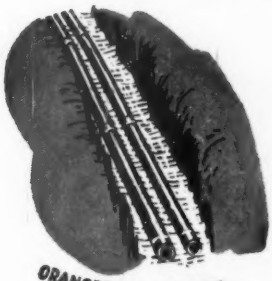
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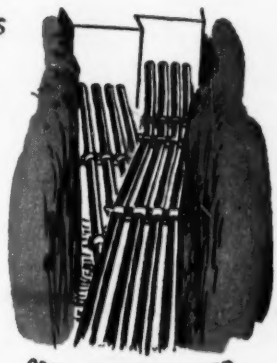
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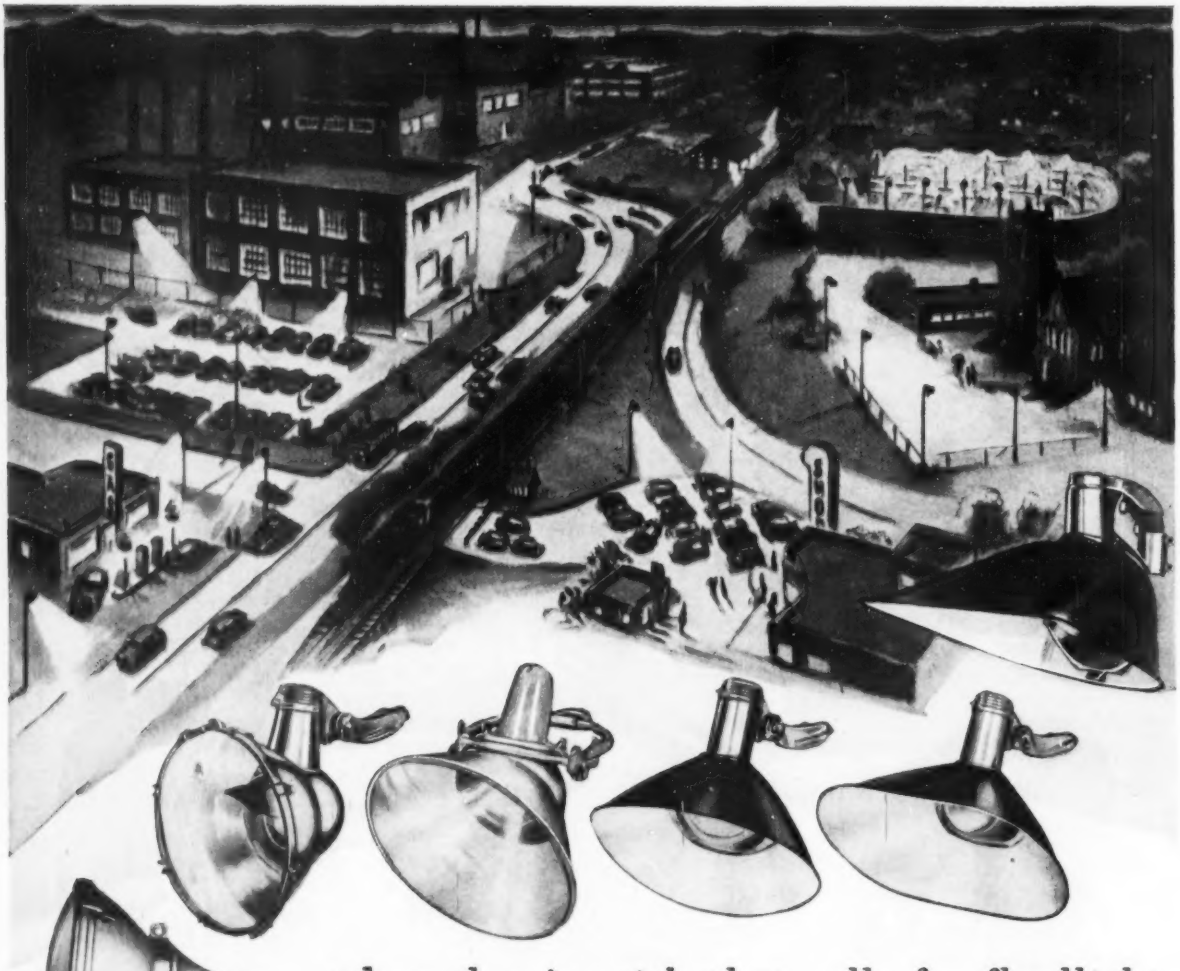

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Whatever your floodlighting requirements, you can rely on Benjamin equipment to do a better job. *"Doing it better"* has been the objective of Benjamin Engineering for over half-a-century. Through the years, Benjamin has pioneered in the use of floodlights in all applications . . . to beautify industrial exteriors . . . to correctly light sports areas . . . to speed up construction . . . to beckon more customers into service stations . . . to facilitate parking for park-and-shop projects, etc. You draw on this vast engineering experience when you specify Benjamin.

That's why you'll find, whatever the floodlighting job, Benjamin Floodlights are time-tested and designed to do it better. They're engineered to deliver sustained performance and original high light output despite continuous exposure to all kinds of weather. Genuine "Life-Time" Porcelain Enamel and "Alzak" Aluminum reflectors simplify upkeep and cleaning of reflecting surfaces. To simplify operation and maintenance, Benjamin Floodlights feature such famous Benjamin engineering refinements as: "Saflox" Floodlight Lowering Devices, patented detachable hood assemblies, convenient pre-setting arrangements and a wider range of brackets and fittings to meet every mounting requirement. Further, every Benjamin Floodlight is specifically designed to meet the requirements of the outside-seeing task with proper shielding, correct light distribution, maximum protection glare and wide range of beam spreads. We will be glad to send you detailed Data Bulletins on any one or all of the floodlights illustrated here. Write Benjamin Electric Mfg. Co., Dept. H, Des Plaines, Ill.

***Here are 8 Benjamin Floodlights that do the job BETTER!** (reading from top to bottom:)*

- "Duo-Service" Floodlight
- "Senior Play-Area" Floodlight
- "Ellipto-Lite Play-Area" Floodlight
- "Olympia" Floodlight
- "Alzo-Lite" Floodlight
- "RD" Floodlighting Projectors
- "Utility" Floodlight
- "Cluster-ettes"

BENJAMIN TRADE MARK

Floodlights

Sold exclusively through electrical distributors. B 537

Modern Lighting

COLOR COMBINATIONS of light are augmented by decorative scheme of pink, grey, yellow and green, plus the many shades of the hats themselves.

Millinery Shop Combines Coves With Spotlights

Several variations of cove lighting plus a pattern of recessed downlights provides an average intensity of 35-footcandles at face level in front of vanity mirrors located in the millinery shop of G. Fox and Co., Hartford, Conn. Coves are equipped with two overlapping rows of 8-foot T-8 deluxe warm white lamps, while downlights house 100-watt incandescent A-lamps backed by specular reflectors.

Hats displayed in wall cases are top lighted by T-12 standard cool white lamps mounted in a single continuous strip shielded by a deep valance running the length of these niches.

Color is pleasingly varied, with the warmth of incandescent lamps and the two-tone fluorescent lighting plan is augmented by pale pink walls and ceiling, grey carpeting, yellow-green chairs and the multi-color millinery displays themselves.

Recessed Troffers for Conference Room

The Conference Room in the First National Bank of Chicago, New York City, is lighted by Curtis Alzak troffers, recessed into an acoustical tile ceiling on 3-foot centers. After the installation had been in use for four months the level of illumination measured 57-footcandles on the surface of the table. Troffers are single-lamp units mounting 40-watt T-17 standard instant-start cool white lamps. Mounting height in this 28-by-16-foot room is 9 feet. The color scheme of the room combines a rose patterned carpeting, light grey ceiling tiles, and wall panels that are variously dark tan, green and grey. Air conditioning units and a smoke exhaust system are also features of this room. The cut-off pattern noticed on the far wall indicates that light from adjacent rows overlaps so that illumination on the conference table is even and shadowless. Brightness contrasts are of a low order, resulting in comfortable conditions for those assembled.

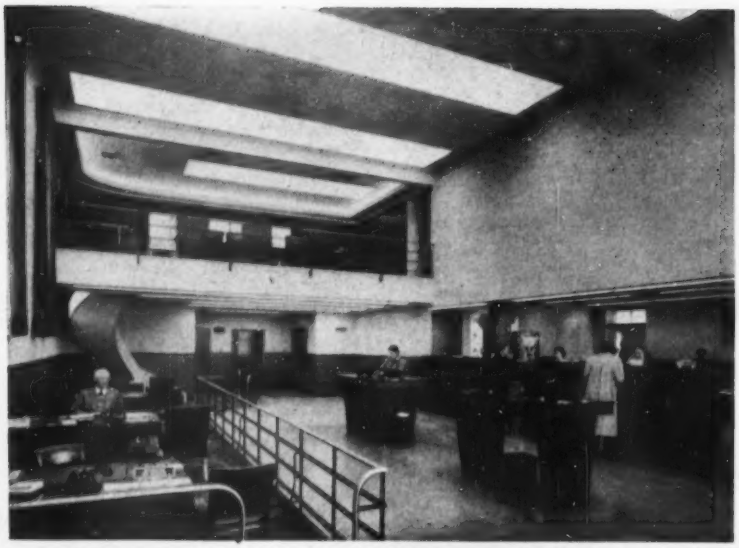
57 FOOTCANDLES are delivered to this conference table by T-17 cool white lamps mounted in Curtis Alzak troffers recessed on 3-foot centers in an acoustical ceiling having a height of 9 feet.

Bank Illumination Provides 120-fc For Cashiers

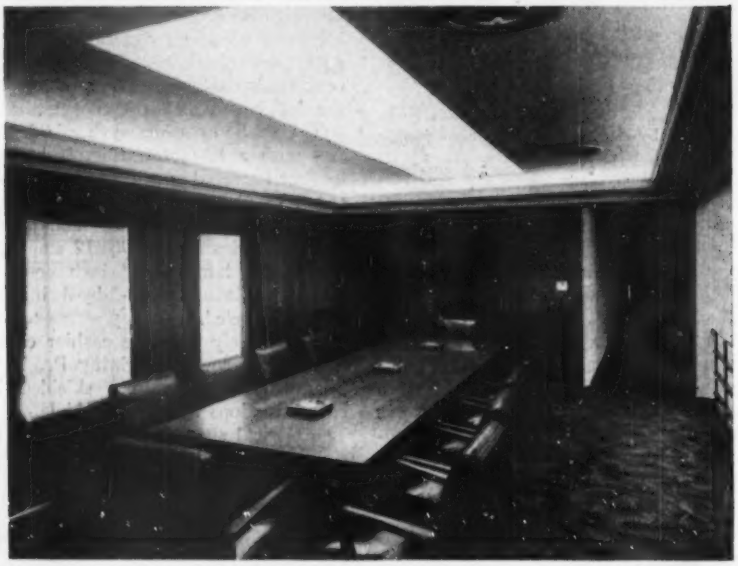
The modern lighting plan installed in the Westfield Federal Savings and Loan Association building in Westfield, N. J., provides 120 footcandles of shadowless illumination on cashiers counters, 65 fc on clerical desks and customers' check counters, 60 on the company's conference table, and 55 on the desks of investment consultants.

The public area, measuring 56-by-26 feet with a 19-foot ceiling, is lighted by four louvered panels, each panel being 4-by-24-feet in plan, with center-to-center distances of 12 feet. Each panel contains twelve 96T12 standard cool white lamps on 9-inch centers. Louver cells are 3-by-3-by-3 inches, white enameled.

Immediately over the cashier cages is a broken row of Lighting Products 2-lamp recessed troffers shielded in both directions by 1-inch cubicle cells. The clerical space behind the cages is similarly lighted, with four continuous rows of similar fixtures mounted on



PUBLIC AREA of Westfield Federal Savings and Loan building obtains 65 footcandles from 24-by-4-foot louvered panels recessed in the 19-foot-high ceiling. Standard cool white lamps are mounted 18-inches above bottom of louvers. (Top)



CONFERENCE TABLE, located on balcony at rear of public area, is lighted by 12-by-4-foot recessed louvered panel, plus continuous cove shielding single row of soft white T-12s. Louvers are ivory, while reflectors above them are white enameled. (Center)

CLERICAL space has average intensity of 65-fc on desks, provided by 2-lamp troffers shielded by 1-inch cellular louvers and mounted on 6-foot centers in the 9½-foot ceiling. Broken line of similar units is mounted directly over cashier cages in a false beam, providing 120-fc in this important area. (Bottom)

6-foot centers in the 9½-foot ceiling. Depending upon lengths of rows, lamps are variously 96- and 48-inch T-12 standard cool white. This area measures 48-by-22½-feet.

A balcony at the rear of the public area serves as a conference center, light being provided by a 12-by-4-foot ivory-colored 3-by-3-by-3 inch louvered recessed panel backlighted by four 96-inch and four 48-inch T12 cool white lamps mounted 18 inches above the bottom of the louvers. In addition to this central panel, a cove encircles the balcony, shielding a continuous row of soft white T-12s.

The floor beneath this balcony is brightly illuminated by a row of 6, a row of 5, two rows of 4 and a row of 2 recessed 2-lamp white-enameled troffers with louvers dimensioned the same as over the clerical area (1-by-1-by-1).

The overall color scheme includes a flat white acoustical plaster ceiling; upper walls of very light green; lower walls of paneled brown wainscoting; central flooring of mottled tan and green terrazzo; carpeting, window drapes and blinds of varying shades of green.

Lightmeter readings were taken after 300 hours of service.

Luminous Ceiling Is Foyer Feature

The modern plant of the Revere Corporation of America in Wallingford, Conn., has an attractive foyer which is illuminated to an average intensity of 120 footcandles by a Martin plastic Marlux ceiling lighted from above by 18 rows of T12 lamps mounted on 12-inch centers. Each row of lamps consists of two 8-foot and one 4-foot tube, making a total of 360 lineal feet of

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Why do more electrical men demand "Scotch" Brand Plastic Tape? Because they know they can depend on top quality. They know it always sticks tight, always has just the right amount of stretch, always handles easily and goes on fast.

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complies with modern 3-wire systems

completely insulated and shockproof

approved 3-wire convenience outlet

impact resisting moulded phenolic handle

model 5025 SLRG

You can now have the safety and convenience of a completely grounded lamp guard equipped with an approved 3-wire convenience outlet. The McGill 5000-G Series portables give you all the light you can use and in addition provide a ready connection for grounding drills, soldering irons, saws or other power tools quickly at the working area . . . without extra extension cords.

McGill grounded guards are available with either the standard closed end cage and reflector or with an open end cage with concentrating end lens (as pictured) to beam light — and rotary reflector. Other models are available with or without convenience outlet, switch, and 25′ to 50′ of red 16-3 SJT Thermoplastic cord and plug.

model 151-CA
Lamp changer

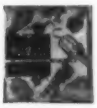
model 3006
Vaporproof

model 5500-SRG
Grounded, no outlet closed end cage

model 7000-SR
Reflector and Switch

model 650-M
Rubber hook handle

all are McGILL® quality



Send for the new McGill catalog No. 49-A describing the complete line of McGill Lamp Guards, Sockets and Switches.

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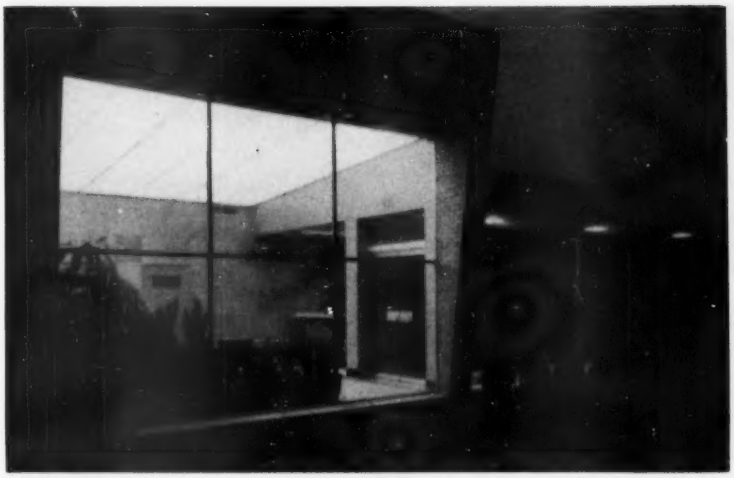
electrical specialties

McGILL MANUFACTURING COMPANY, INC. 450 N. Campbell St., Valparaiso, Indiana



NIGHT VIEW of Revere foyer shows slanting luminous ceiling illuminated by 18 rows of fluorescent lamps on 1-foot centers. Intensity of 120-fc is measured at normal waist level. All-glass front, natural wood wall panels, green terrazzo flooring, red furniture and artistic plant arrangements give this area eye-appeal.

fluorescence above the 21-by-19-foot floor area.

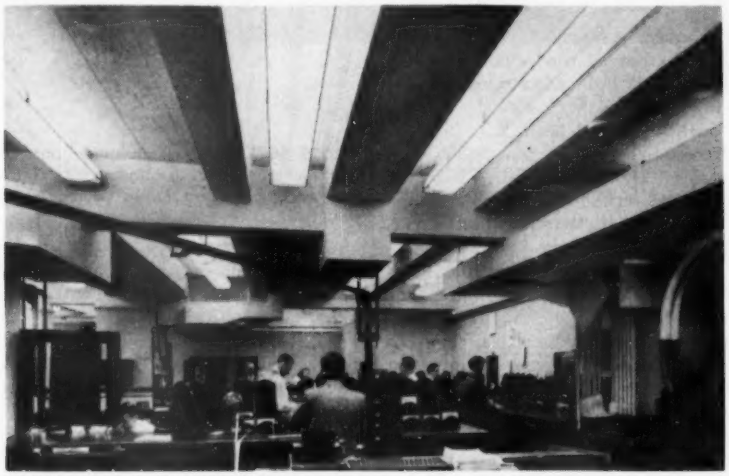
Just off the foyer is a receptionist's desk, lighted by two 3-lamp recessed troffers mounting 96T12 lamps, diffused by corrugated glass bottom panels. Illumination is 40-fc.

Architectural interest is heightened by the fact that the ceiling slants upwards from a height of 10½-feet at the rear of the foyer to an elevation of 12-feet at the window line. This all-glass front consitutes an attractive display of plants backed by light colored natural wood panelled walls. Green terrazzo flooring and red leathered upholstered chairs further enhance the attractiveness of this central area.

Difficult Lighting Problem Handled By Grenadiers

A maze of structural beams, air conditioning ducts and various systems of exposed utility piping combined to make the lighting of a New York City Wall Street wire room a difficult problem. The firm of Hornblower and Weeks now have an acceptable installation, however, through the judicious location of 34 Wakefield Grenadier 2-lamp louvered fixtures lamped variously with 96-, 72- and 48-inch T-12s.

Fixtures are generally positioned in continuous rows and, depending upon duct arrangements, the luminaires are approximately 4-feet on centers. By suspending the fixtures on short 4-inch stems, lighting of the desks is surprisingly even and, by using a light colored natural buff acoustical plaster ceiling, cream colored beams and ducts, light green walls and a light tan floor covering, reflectance is of a high order.

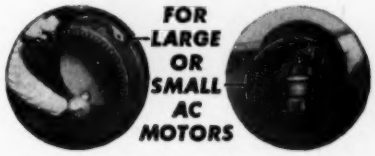


LOUVERED 2-LAMP FIXTURES, mounted on short stems between maze of ducts and beams, provides average 50-fc lighting for desks and working surfaces in wire room of this Wall Street office.

Now Find ANY COIL SHORT Instantly!

the New CROWN INTERNAL GROWLER

- POSITIVE—no chance for error
- FAST—"Pinpoints" exact location of shorts
- EASY—Anyone can use it
- CHECKS—Stators, 6" ID up—Armatures, 6" to 14" dia.—Rotors, for loose bars



Does away with wasted time and guesswork of hacksaw blades or vibrating reed type testers. Self-contained meter and pick-up check each coil as it is excited—once around armature, stator or rotor locates all shorts. Finds shorts that give too weak an indication to be found by other means and reveals them with a definite movement of the meter needle. Operates on 115 V, A.C. Built to highest standards of dependability and accuracy.

$37.30 F.O.B. WOODSTOCK, ILL. State or local sales tax extra

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A practical solution . . .

—where weatherproof installations are important . . .

—where light-weight strength really counts . . .

. . . insist on

Cast Aluminum Junction Boxes

"Adalloy", the aluminum alloy of high tensile strength, is rustless, of course. Easy to handle.

Each of the three types illustrated is offered in a wide range of standard sizes, and specials. Available drilled and tapped to specifications; with or without mounting lugs.

Ask for full information and prices.

THE ADALET MANUFACTURING CO.
CLEVELAND 11, OHIO

WALL NICHE equipped with freely suspended frames and glass shelves is top lighted by continuous rows of cool white fluorescent lamps shielded by deep coves. General area obtains 20-footcandles of illumination from Silvray Skylike units mounted on 10-by-10-foot centers.

China Displayed by Overhead Strips

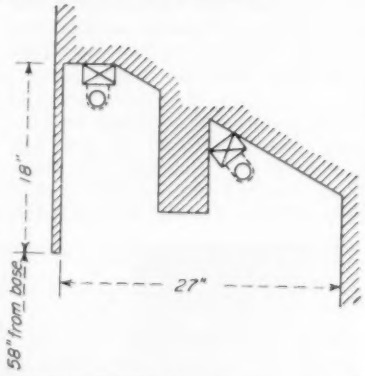
China is effectively displayed in G. Fox and Company's modern department store in Hartford, Conn., by two continuous rows of 40-watt standard cool white T-12 fluorescent lamps mounted end-to-end above glass shelves and free-standing gold-colored wood frames spaced along a 58-by-27-inch wall niche which runs the length of an entire wall.

The front row of lamps is shielded by a deep (18-inch) plywood cove while the second row, mounted on an angle to kick light slightly towards the rear is shielded from view by a 5-by-11-inch structural beam.

Intensities of 85 footcandles are measured on the top shelf, 75 on the second, 45 on the third and 40 on the bottom. The background for this display is painted a light yellow-green.

An average intensity in the main part of the store is 20 footcandles, provided by Silvray Skylike units equipped with 300-watt silver-bowl lamps. These units are mounted on 10-by-10-foot centers, suspended at the elevation of structural beams which are approximately 12½-feet above the floor level.

Since the merchandise on display consists of glassware and glazed china, the impact of illumination from the overhead sources results in an eye-appealing sparkle which contributes materially to the salability of the products. The free-standing nature of the frames, suspended as they are with gaps between all sides and adjacent woodwork, also provides an interesting optical illusion which adds definite showmanship to this sales area. Favorable comments on the entire installation have been received from customers and store personnel alike.

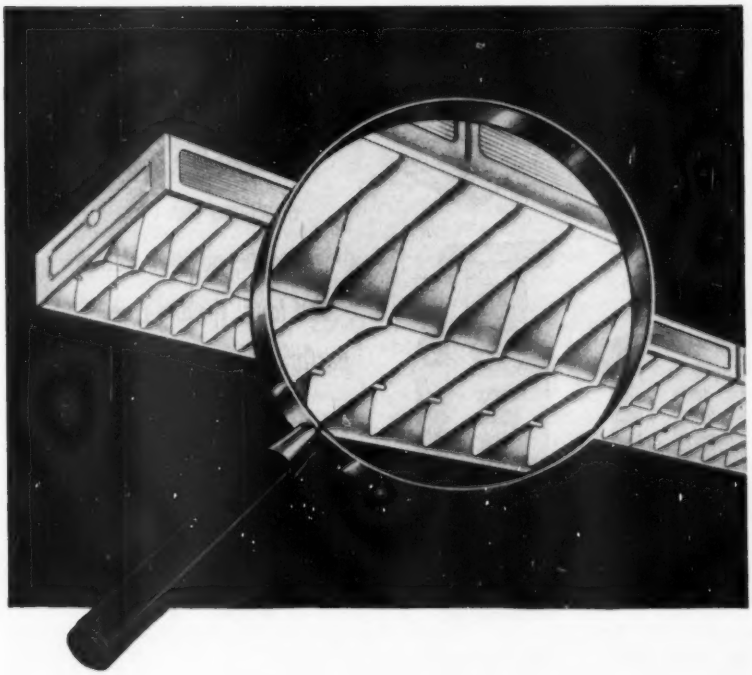


CROSS SECTION through upper part of wall niche indicates arrangement of channels and fluorescent lamps behind beam and front cove.

Day-Brite "Close-up" Quality

MAKES YOUR PROFITS SAFE

because it makes satisfied customers



THIS IS A CLOSE-UP of the *interlocking louver* feature of Day-Brite's PLEXOLINE® fixtures. Each cross-wise louver is firmly locked into the center "V" louver and is tied at both ends by a steel rod. The whole shielding unit is rigid. It won't sag. It won't rattle. Louvers will not twist or bend out of shape during installation or when the fixture is being cleaned or relamped.

THIS "CLOSE-UP" QUALITY FEATURE is important to you because it helps make installation easier, faster and more profitable. It means *safer profits* through elimination of costly, time-consuming "call-backs."

310

DAY-BRITE BUSINESS IS PROFITABLE BUSINESS

Day-Brite is a contractor's line—designed and built to cut installation time and help you make more money. When you specify and install Day-Brite you *keep* those bigger profits, too. Day-Brite makes satisfied, enthusiastic customers—the kind that recommend you to other prospects instead of haunting you with profit-robbing "call-backs."

YOU'LL FIND THE DAY-BRITE REPRESENTATIVE IN YOUR AREA HELPFUL AND COOPERATIVE

There are Day-Brite representatives in 45 cities across the nation. If you're not already acquainted with your nearest Day-Brite representative write today for his name and address. You'll find him an experienced, competent lighting man and he has information that can make your business better.

* * *

Day-Brite Lighting, Inc., 5402 Bulwer Ave., St. Louis 7, Mo. In Canada: Amalgamated Electric Corp., Ltd., Toronto 6, Ontario.

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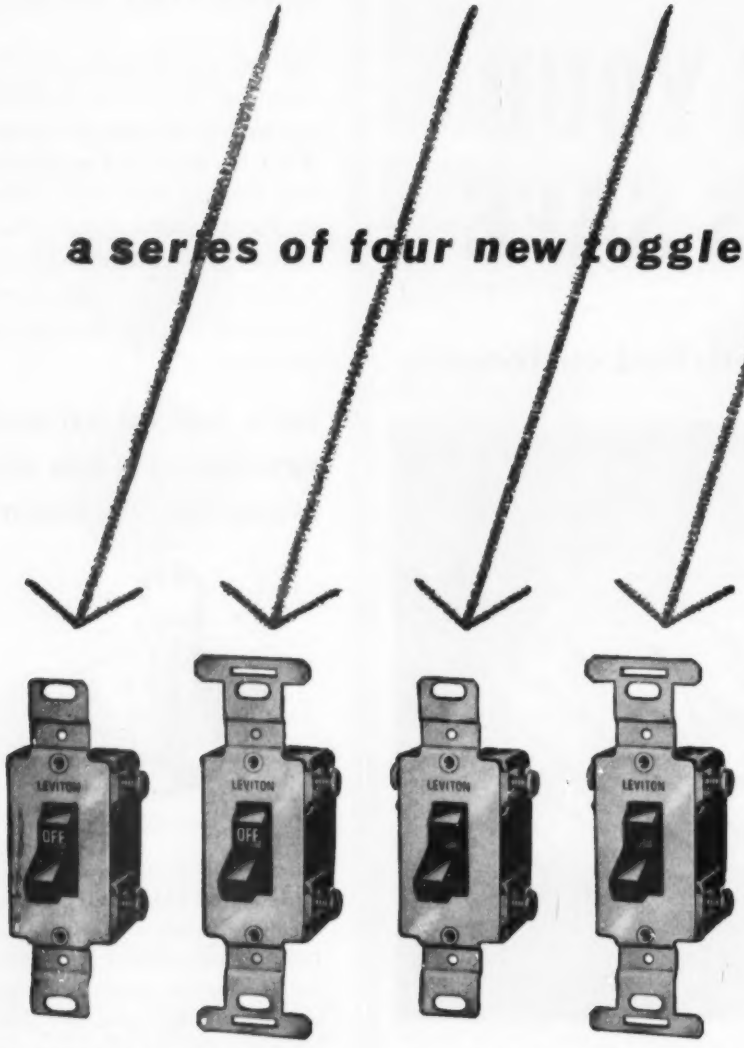
DAY-BRITE
Lighting Fixtures

a series of four new toggle switches



No. 1230 S. P.

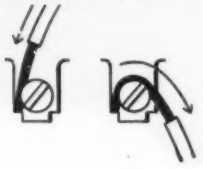
No. 1330 S. P.
(with plaster ears)

No. 1231 3-way

No. 1331 3-way
(with plaster ears)

the finest switches in their class ... a new, competitively priced line, designed for durable, positive action and long, trouble-free performance.

showing new easy method of wiring



New features *include heavy duty housing with straps rivetted to bakelite cup large, staked binder head screws backed out for faster wiring, and sturdy, fast-acting mechanism with double wiping contacts*

Rated 5A.-250V., 10A.-125V.

Toggles are available in brown or ivory

Built to meet Underwriters Laboratories and Canadian Standards Association specifications

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In The News

Winners in Lighting Competition

Judges select prize winning entries in the First National Lighting Competition for Electrical Contractors, make 31 awards in six classifications

THE Board of Judges for the National Lighting Competition for Electrical Contractors, sponsored by *Electrical Construction and Maintenance*, awarded a total of 31 prizes and honorable mentions to lighting entries submitted for this contest. Meeting in New York on Friday, August 14, this five-man team of well-known authorities in the lighting industry devoted the entire day to the review and study of the large number of entries submitted.

Of the 31 awards made, 18 were cash prize awards and 13 were honorable mentions. First, second and third prize awards were issued in each of six lighting classifications: stores, offices, industrial, residential, floodlighting, and miscellaneous. First prize winners received cash prizes of $100; second, $50; and third, $25. Certificates of award were also issued to all prize winners, and to winners of honorable mention.

Contestants from 19 states and one foreign country entered the competition.

The eighteen cash awards totaling $1,050 and the 13 honorable mentions were awarded. Pennsylvania held first place with a total of seven prize winners and six honorable mentions. California placed second with two prize winners and two honorable mentions.

The competition was open to electrical contractors or full-time employees of regularly established electrical contracting firms only. The rules also stipulated that a lighting installation, in order to be eligible for the competition, must have been initiated by the contestant's firm. It is the first lighting competition ever sponsored on a nation-wide basis exclusively for electrical contractors and their employees. It was specifically designed "to encourage, and to extend public industry recognition to, electrical contractors and their employees who initiate, sell and install outstanding lighting installations, and to further the dissemination of meritorious lighting information". Prize winning entries will be featured in forthcoming issues of *Electrical Construction and Maintenance*.

All branches of the lighting industry enthusiastically supported this contest, and aided in its promotion with electrical contractors. As indicated by the wide geographical distribution of the 31 awards, the contest inspired new interest in good lighting across the entire nation.

The contest judges were: Carl W. Zersen, managing director of the Chicago Lighting Institute, chairman; Richard Kelly, lighting consultant, New York City; Everett M. Strong, professor of electrical engineering, Cornell University, Ithaca, N. Y.; Joseph S. Schuchert, commercial sales manager, Duquesne Light Company, Pittsburgh; and Willard W. Thompson, consulting electrical engineer, Thompson Engineering Company, Boston, Mass.

Winners in the competition were as follows:

Store Lighting

FIRST PRIZE: Edward B. Barber, Independent Wiring Co., Philadelphia, Pa.

SECOND PRIZE: Lyle E. Johnson, Juneman Electric Co., Inc. Birmingham, Ala.

THIRD PRIZE: Francis E. Havener, Rockland, Me.

LIGHTING COMPETITION JUDGES were (l. to r.): Richard Kelly; Everett M. Strong; Carl W. Zersen, chairman; Willard W. Thompson; and Jos. S. Schuchert.

AFTER THE STORM WAS OVER

Tornado? Impossible! Not in New England! Yet, it came. And with it—disaster! The toll—87 dead! Hundreds injured! Thousands homeless! Power companies seriously crippled! Worcester, Mass., was like a city paralyzed.

Help was urgently needed to start the tremendous task of rebuilding power lines and restoring service. Almost immediately, Wesco arrived on the spot. Operating on a round-the-clock schedule, Wesco brought its vast electrical resources into the "battle for power". In effect, Wesco became an "emergency squad" dispatching salesmen to various trouble spots—determining electrical needs—rounding-up material and arranging rush deliveries. Warehouses in Boston, Providence and Manchester were tapped to fill the requirements of the stricken area.

So—in disaster as in the normal flow of business—Wesco service and teamwork stand ready to meet new challenges, new problems in the field of electricity. With its vast purchasing power . . . specially trained personnel . . . its huge stocks of electrical supplies . . . and its years of experience in the field . . . Wesco is especially equipped to offer your job dependable, up-to-date service.

Whatever your electrical problem may be . . . you can count on Wesco.

Westinghouse Electric Supply Co.

A NATIONAL DISTRIBUTING ORGANIZATION

40 WALL STREET, NEW YORK, N. Y.

HONORABLE MENTIONS: Earl Pridemore, Pacific Electric Co., San Diego, Cal.; V. R. Knight, California Electric Works, San Diego, Cal.; and Eugene G. Lombard, Lombard Electric Co., Wauwatosa, Wisc.

Office Lighting

FIRST PRIZE: M. R. Minto, MacNutt Electric Co., New York, N. Y.
SECOND PRIZE: T. J. Reilly, Frame Electric Co., Pittsburgh, Pa.
THIRD PRIZE: Frank R. Haubelt, Haubelt Electric Co., Knoxville, Pa.
HONORABLE MENTIONS: T. J. Reilly, Frame Electric Co., Pittsburgh, Pa.; John E. Cook, Independent Wiring Co., Philadelphia, Pa.; J. D. Dunlop, East Liberty Electrical Service, Pittsburgh, Pa.; S. C. Blumenthal, Jr., Blumenthal-Kahn Elec. Co., Inc., Baltimore, Md.; and Frank R. Haubelt, Haubelt Electric Company, Knoxville, Pennsylvania.

Industrial Lighting

FIRST PRIZE: Wm. G. Stockhausen, Central Electric Co., Baltimore, Md.
SECOND PRIZE: Wm. Hertel, Jr., Hertel Electric Co., Grand Rapids, Mich.
THIRD PRIZE: James Maniscalco, Norristown, Pa.

Residential Lighting

FIRST PRIZE: Edgar Sattes, Forest City Electric Co., Cleveland, Ohio.
SECOND PRIZE: Robert Smith, Jr., Philadelphia, Pa.
THIRD PRIZE: George H. Meese, George Meese Electric Co., Carlsbad, Cal.

Floodlighting Lighting

FIRST PRIZE: M. R. Minto, MacNutt Electric Co., New York, N. Y.
SECOND PRIZE: George P. Bailey, George P. Bailey & Sons, Bristol, Pa.
THIRD PRIZE: Donald Press, Flood-Lite Service, Inc., Los Angeles, Cal.
HONORABLE MENTIONS: Agnes Whitfield, McGee Electric Co., Clearwater, Fla. and Lyle E. Johnson, Juneman Electric Co., Inc., Birmingham, Ala.

Miscellaneous Lighting

FIRST PRIZE: Fay Foster, Stoneburner-Verret Elec. Co., Port Arthur, Tex.
SECOND PRIZE: George A. Denner, Clement Co., Grand Rapids, Mich.
THIRD PRIZE: Leo Stacer, Stacer Electric Co., Homestead, Pa.
HONORABLE MENTIONS: Robert Moser, Moser Electric Co., Fort Worth, Tex. and two honorable mentions to T. J. Reilly, Frame Electric Co., Pittsburgh, Pa.

ELECTRICAL INSPECTORS Herman Lenk, Neil Fisher, Charles Ward and Rudolf Fries, who participated in a discussion of the National Electrical Code at a meeting of the Passaic County Electrical League.

Electrical Industries Show To Be Held in N. Y.

New electrical products that make living safer and easier in the U. S. today, and many electronics-age product developments, will be exhibited at the Second National Electrical Industries Show, at the 69th Regiment Armory, New York City, September 29 through October 2.

More than 130 of the country's leading electrical manufacturers will bring to the show, sponsored by the Eastern Electrical Wholesalers Association, new equipment and devices that make the American people the greatest consumers in the world of harnessed electrical energy.

Because of the ever-mounting use of electricity in homes and in industry, the show will be built around the theme, "Safety Through Adequate Wiring" and will launch a nationwide drive to bring all phases of the electrical industry into a program aimed at promoting modernization of wiring systems.

New IES Officers

The Illuminating Engineering Society has announced its officers for the coming fiscal year which begins October 1, and ends September 30, 1954. These are as follows:

President—A. Homer Manwaring, Executive Vice-President, Philadelphia Electrical & Manufacturing Co., Philadelphia, Pa., who has served as IES Vice-President for the past two years. He succeeds Everett M. Strong, head of the Department of Electrical Engineering, Cornell University, Ithaca, N. Y., who was President for the fiscal year 1952-53.

Sr. Vice-President—Duncan M. Jones, Eastern Canada representative for Curtis Lighting of Canada, Ltd., Montreal, Quebec, Canada, who was Jr. Vice-President for the fiscal year 1952-53.

Jr. Vice-President—R. F. Hartenstein, Supt. Electric & Steam Heating Sales, Ohio Edison Company, Akron, Ohio.

General Secretary—Marshall N. Waterman, Asst. Manager Commercial Engineering, Westinghouse Lamp Division, Bloomfield, N. J.

Treasurer—Kirk M. Reid, Head of Section, Engineering Division, General Electric Company, Nela Park, Cleveland, Ohio.

Directors—Two new Directors were elected, who will serve a three-year term. They are: C. C. Shotwell, Asst. Manager, Market Studies & Service Division, Philadelphia Electric Co., Philadelphia, Pa., and W. A. Stannard, General Lighting Sales Supervisor, Consumers Power Co., Jackson, Michigan.

Four other Directors previously appointed to three-year terms who will continue in office are: G. W. Beals, The Miller Company, Meriden, Conn.; Jos. S. Schuchert, Duquesne Light Co., Pittsburgh, Pa.; J. F. Whitehead, Jr., Day-Brite Lighting Corp., St. Louis, Mo.; and F. C. Winkler, Westinghouse Electric Corp., Cleveland, Ohio.

Regional Vice-Presidents—The IES has divided U. S. and Canada into ten geographical regions, each of which has its own Vice-President. These officers each serve a two-year term, with half of them being elected each year. The five newly-elected Vice Presidents who will begin their two-year terms October 1st are: Clarence J. Berry, Manager, Lighting Service Department, Consolidated Gas Electric Light & Power Co., Baltimore, Md.—East Central Region; G. B. Buck, II, District Engineer and Sales Promotion Manager, Rocky

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for dependable
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Engineering improvements in the design and construction of ROYAL-NOARK cartridge fuses mean that they stay cooler . . . give greater protection to vital equipment.
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Quality
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famous ROYAL "Crystal" PLUG FUSES
ROYAL ELECTRIC CO., INC. PAWTUCKET, R. I.

Mountain District, General Electric Lamp Division, Denver, Colo.—Inter-Mountain Region; Milton B. Hastings, President, Powerlite Devices, Ltd., Toronto, Ontario, Canada—Canadian Region; M. J. Myers, Jr., Lighting Director and Industrial Engineer, Public Service Co. of Oklahoma, Tulsa, Okla.—Southwestern Region; and Glenn E. Park, District Manager, Carolina Sales District, General Electric Lamp Division, Charlotte, N. C.—Southern Region.

Regional Vice-Presidents serving out the second year of their two-year terms are: Lester C. Twichell, Rochester Gas & Electric Corp., Rochester, N. Y.—Great Lakes Region; George J. Taylor, Day-Brite Lighting, Inc., New York, N. Y.—Northeastern Region; Walter J. Lind, Canadian General Electric Co., Ltd., Vancouver, B. C.—Pacific Northwest Region; L. A. Hobbs, Smoot Holman Co., Inglewood, Calif.—South Pacific Coast Region. Clarence B. Pederson, Illinois Bell Telephone Co., Chicago, Ill. was appointed in June to fill out the term vacated by the resignation of L. B. Paist, Northern States Power Co., Minneapolis, Minn. for the Midwestern Region.

IAEL Elects Officers

The 18th Annual Conference of the International Association of Electrical Leagues was held at the Fairmont Hotel, San Francisco, California, August 5-8.

Managers of 25 electrical leagues (including two from Canada) from all sections of the United States were in attendance. Other conferees were representatives of various branches of the electrical industry—utilities, distributors, contractors, dealers and the electrical industry press.

In addition to discussion of subjects, representing various phases of promotion in the electrical industry, which could be undertaken co-operatively, there were two forums to discuss individual problems met with in electrical league operations.

The address of welcome was made by J. S. C. Ross, of Pacific Gas and Electric Company, who is chairman of the Executive Committee of the Northern California Electrical Bureau. The keynote address was delivered by R. B. Hubbard, president of the Association.

Subjects presented by speakers included "The Outlook—Power, Appliances, Sales Potentials"; "Retailing—Channels, Trends"; "The Path to Profit for Electrical Small Business"; "Down the Stretch to Light's Centennial"; "New Horizons for the Tele-

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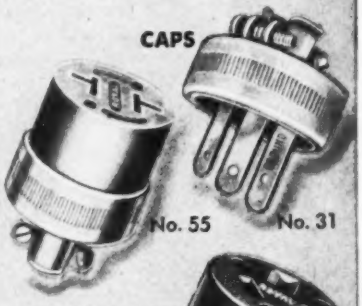

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Sound engineering, quality materials, and experienced manufacturing skill make ROYAL wiring devices better for you these three ways: 1) they're easy to wire; 2) always dependable; and 3) long life under constant use.
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BIDDLE
Instrument News

- ELECTRICAL TESTING INSTRUMENTS
- SPEED MEASURING INSTRUMENTS
- LABORATORY & SCIENTIFIC EQUIPMENT

JAMES G. BIDDLE CO., 1316 ARCH ST., PHILADELPHIA 7, PA.

Photo Courtesy Copperweld Co.

ARE YOU SURE OF PROTECTION THROUGH YOUR GROUND CONNECTIONS?

MEGGER® Ground Tester measures low resistance

In spite of apparently good lightning rod or arrester protection, lightning frequently will cause severe damage if high ground resistance hampers its dissipation in the earth. Lightning storms are prevalent in the northeastern states during the spring and fall months. Plants in this section should make a thorough round of ground resistance tests. Aside from the hazards to personnel, thousands of dollars may be saved in damage to electrical equipment and in loss of power and stoppage of production.

The MEGGER® Ground Tester is the easiest, quickest and most accurate method of determining ground resistance. It is an instrument specially designed for the purpose and should be used wherever possible. Direct readings are automatically obtained in ohms. It provides its own source of current—no batteries, or other remote source required. It's easy to carry, too. Has approval of the Associated Factory Mutual Insurance Companies.

Don't put it off—write today for "Grounding Electrical Circuits Effectively" by J. R. Eaton **(Bulletin 25T2-ECM)** and our Biddle manual on "Ground Resistance Testing" **(Bulletin 25J-ECM).**

Tips on TESTING . . .

. . . ELECTRICAL INSULATION RESISTANCE

Reconditioning Wet Apparatus

The bad effects of excessive moisture in insulating material, particularly when localized, are numerous. The effect most likely to result in failure in the early stages of exposure is that of low resistance paths which may develop either through or over the surface of the insulation. The likelihood of failure from this cause is increased by the presence of dirt and other foreign matter, and may occur in either organic or inorganic insulating material.

If moisture has been deposited on clean insulation only superficially, then the heat resulting from the normal operating temperature of the equipment may remove it before failure occurs. However, the normal operating heat of at least some parts of the equipment is sometimes insufficient to drive out moisture that has penetrated through surface defects.

If moisture is allowed to remain in insulation, it usually—in time—causes corrosion of metal conducting parts, aggravated by the presence of chemicals and electric potential, thus increasing the danger of failure.

In addition to apparatus which may be exposed to moist atmosphere, or wet with fresh water, there may be occasions when it becomes necessary to rehabilitate equipment that has been subjected to salt water. In such case, clean fresh water must be used to remove all traces of salt before drying of the apparatus is attempted. Any evidence of oil or grease on the insulation should also be removed by using a volatile solvent such as carbon tetrachloride.

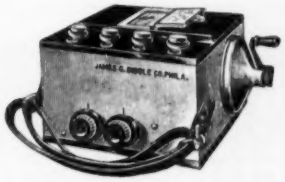
Then the apparatus must be dried out before electrical potential is applied. Numerous methods and various temperatures for drying out electrical equipment are used, including forced hot air, ovens, circulating electric current through the conductors, or combinations of these methods. Local conditions and facilities, manufacturer's recommendations, and the type of equipment involved, dictate the method used.

Test Procedure

If possible, secure records of previous insulation resistance tests on the apparatus.

Make short-time tests and time-resistance tests for comparison to help decide whether drying is necessary. If present readings are at all comparable with previous tests made at or corrected to the same temperature, a drying-out run *may* not be necessary.

NOTE: *The above material is taken from our Instruction Manual—for the use of Megger Insulation Testers. Within its 96 pages, such subjects as "Temperature Correction", "Interpretation" and many others are discussed in a clear and interesting manner with very ample illustrations, charts and tables. We'll be glad to send you a copy of this manual without obligation. Just write on your company letterhead for* ***Manual 21-J-ECM.***



INSULATION TESTER & WHEATSTONE BRIDGE in ONE EASILY PORTABLE INSTRUMENT

Measures Electrical Resistances From a Fraction of an Ohm up to 1000 Megohms

Affords the facility of:

- **A Wheatstone Bridge** for measuring conductor resistance of coils, resistors and circuits.
- **A Megger Direct Reading Ohmmeter** for measuring electrical insulation resistance (ohm and megohm scales).
- **A Varley Loop Feature** for locating faults on wires (optional).

This Bridge-Meg weighs only 15 lbs. and is completely self-contained with its own constant-voltage generator—no need to be dependent on batteries or other suitable test current.

Why burden yourself with two instruments when you can have the facilities of two for little more than the price of one In one compact, sturdy case. For complete details and prices write for **Bulletin 21-60-ECM.**

9018

JAMES G. BIDDLE CO.

- ELECTRICAL TESTING INSTRUMENTS
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More Light with Same Power Load

Plus

INDOOR OUTDOOR
High or Low Bay Installation

No Dirt-catching Reflectors

200 to 1000 Watts
St'd. or High Voltage

HARD GLASS
Won't crack due to sudden temperature changes, moisture, and flying insects.

LOW MAINTENANCE
No reflectors to clean. Higher light output maintained throughout life of lamp with sealed-in silver reflector.

LOW COST INSTALLATION
Only simple socket required for high or low bays. Uses light-weight, low-cost weatherproof outdoor lamp holders.

Send for Technical Bulletin 80

NICKEL PLATED BASE
WEATHERPROOF HARD GLASS
SILVER REFLECTOR INSIDE STAYS BRIGHT ALWAYS
MAXIMUM LIGHT OUTPUT · WIDE BEAM

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GUIDE TO
Efficient
Economical
DRY TYPE
TRANSFORMER
INSTALLATIONS

PRECISION
Air-Cooled
TRANSFORMERS

FOR POWER AND LIGHTING DISTRIBUTION

- Built to meet latest N.E.M.A. standards
- Class "B" insulating material
- Ruggedly constructed for long, trouble-free service
- Easy accessibility and maintenance
- Economical to operate
- Economical to maintain
- Manufactured by pioneers of dry type transformers
- Serving leading industries and government installations
- PROMPT DELIVERIES — Most sizes direct from stock

SINGLE AND 3 PHASE
¼ TO 1000 KVA

ALL VOLTAGES
Special Transformers • Isolating Transformers • Saturable Reactors • Regulating Transformers • Rectifiers • Electronic Devices • Street Lighting

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TO GOTHAM for the NISA get-together went C. R. Durand, H. N. Crowder Jr. Co., Allentown, Pa., and George R. Lockwood, Lockwood's Electric Motor Service, Trenton, N. J.

vision Industry"; "Electrical Week in Michigan"; "Legal Aspects of League Operations"; "Room Coolers Are Hot"; "What We Know About Electric Air Heating" and "Adding Business Through the Open-end Mortgage".

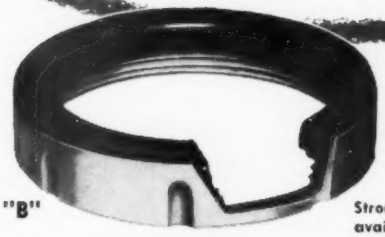
The above subjects were dealt with, respectively, by George C. Tenney, president, McGraw-Hill Company of California, San Francisco; Kenneth L. Hampton, manager, Valley Electrical Supply Company, Fresno; Richard M. Oddie, director, Small Business Advisory Service, Bank of America, San Francisco; W. H. Robinson, Jr.; advertising and promotion, Lamp Division, General Electric Company, Cleveland; Robert S. Bell, executive vice president, Packard-Bell Company, Los Angeles; Kent P. Stiner, engineering coordinator, BullDog Electric Products Company, Detroit; Walter J. Walsh, attorney, San Francisco; W. H. Eichelberger, vice president in charge of merchandising, Philco Corporation, Refrigeration Division, Philadelphia; Edwin Fleishman, consulting engineer, San Francisco, and Charles Wellman, executive vice president, Glendale Federal Savings and Loan Association.

Among the special features was a luncheon address on the subject, "Industrial Development of the West" by O. R. Doerr, vice president, Pacific Gas and Electric Company, and an address at the annual banquet by R. R. Gros, manager, publicity and advertising, Pacific Gas and Electric Company, San Francisco, on the subject, "Freedom Is Never Free".

Subjects discussed at the forums included electrical industry shows, contractor services programs, electrical buyer's guide, 4-H project for electrical safety education, air conditioning, television servicing and others.

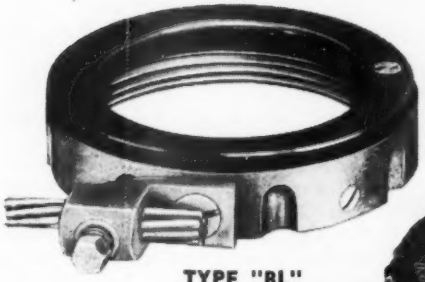
On Saturday morning, August 8, officers and members of the Board of Governors were elected for the year 1953-54 as follows:

THERE'S AN O.Z. BUSHING FOR EVERY JOB



TYPE "B"

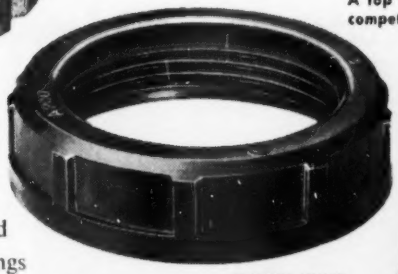
Strongest insulating bushing available! Exclusive design permanently locks insulation into casting.



TYPE "BL"

Same as proven Type "B" with lug for quick, positive ground connections. Set screw in casting facilitates positioning.

Finest, high-strength, all-Bakelite insulating bushing. A top quality bushing—competitively priced!



TYPE "A"

All-Bakelite bushing with male thread for insulation of exposed cables passing through holes in metal boxes or troughs.

TYPE "BB"

Over 35 years of specialized experience in the design and manufacture of conduit fittings is behind the complete line of O.Z. insulating bushings. Whatever your insulating bushing problem, you can be sure there is an O.Z. design to fit your application perfectly. Buy O.Z. bushings from your local electrical distributor.

O.Z. ELECTRICAL MANUFACTURING CO., INC.

262 BOND ST. • BROOKLYN 2, N. Y.

CAST IRON BOXES • SOLDERLESS CONNECTORS
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Representatives in all principal cities

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ELECTRIC MFG CO CHICAGO U.S.A.

HEADQUARTERS
for HINGED AND RIGID POLES

Nowhere else can you find a greater assemblage of Poles than in the REVERE line.

New building programs are your opportunity to capitalize on this profitable business . . . and it leads to volume floodlight sales.

Be prepared to book orders for Ventilated Flag or Service Poles for venting oil tanks—Rigid and Hinged High Mounting Poles for Sports, Industrial, Service Station and Commercial Lighting Projects.

Write for selling data.

REVERE ELECTRIC MFG. CO. 6017 BROADWAY CHICAGO 40, ILL.
INDOOR & OUTDOOR LIGHTING FOR EVERY NEED

. . . and the
FLOODLIGHTS
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WITH THEM

750-1000-1500 WATT ENCLOSED FLOODS

300 to 1500 WATT ELIPTOR FLOODS

18 and 20 in. REAR SERVICE FLOODS

300 to 1000 WATT ENCLOSED FLOODS

"ENDOVAL" MERCURY-VAPOR LUMINAIRE

A Journeyman's Tool, built to stand up under constant, on-the-job Contractor or Industrial use

● **NO STARTING HOLE NEEDED**...Simply place guide next to material and "rock" tool into an upright position.

● **CUTS RIGHT THRU IMBEDDED NAILS** . . . wood, plaster, iron pipe, sheet metal, "Transite" and most other materials—even in cramped quarters.

● **FITS ANY HEAVY DUTY ¼" or ⅜" DRILL**...as easy as changing bits! Overall length only 10¾"; weight only 3 lbs. 6 ozs.

● **ANTI-FRICTION REPLACEABLE BEARINGS—BUILT-IN BLOWER** . . . Blower keeps tool comfortably cool even under continuous use—blows dust and chips away from cutting line. All friction surfaces are of "Oilite," phosphor bronze or high speed ball bearings. All wearing parts are replaceable.

Write for Bulletin No. Y-9.

Cutting opening in oak flooring in less than 3 minutes—no starting hole needed!

R.C.S. TOOL SALES CORPORATION Joliet, Illinois, U.S.A.

Federal Procurement Officials will find Super Saws listed in Federal Supply Schedules, Class 40 Materials.

President—A. L. Maillard, Indianapolis; Vice President—H. E. Cook, Detroit; Treasurer—E. J. McGinnis, Cincinnati; and Secretary—A. H. Kessler, Minneapolis.

The balance of the Board of nine members was completed by electing the following men: Division I—W. G. Hills, Washington, D. C.; Division II—S. E. Strunk, Cleveland; Division III—D. E. Rosenthal, Omaha; Division IV—G. L. Logan, Los Angeles; and Division V—J. F. Mowat, Toronto.

The immediate past president, R. B. Hubbard of Denver, will serve as an advisory member to the Board.

O. C. Small, manager of the Business Development Department of NEMA, was reappointed corresponding secretary.

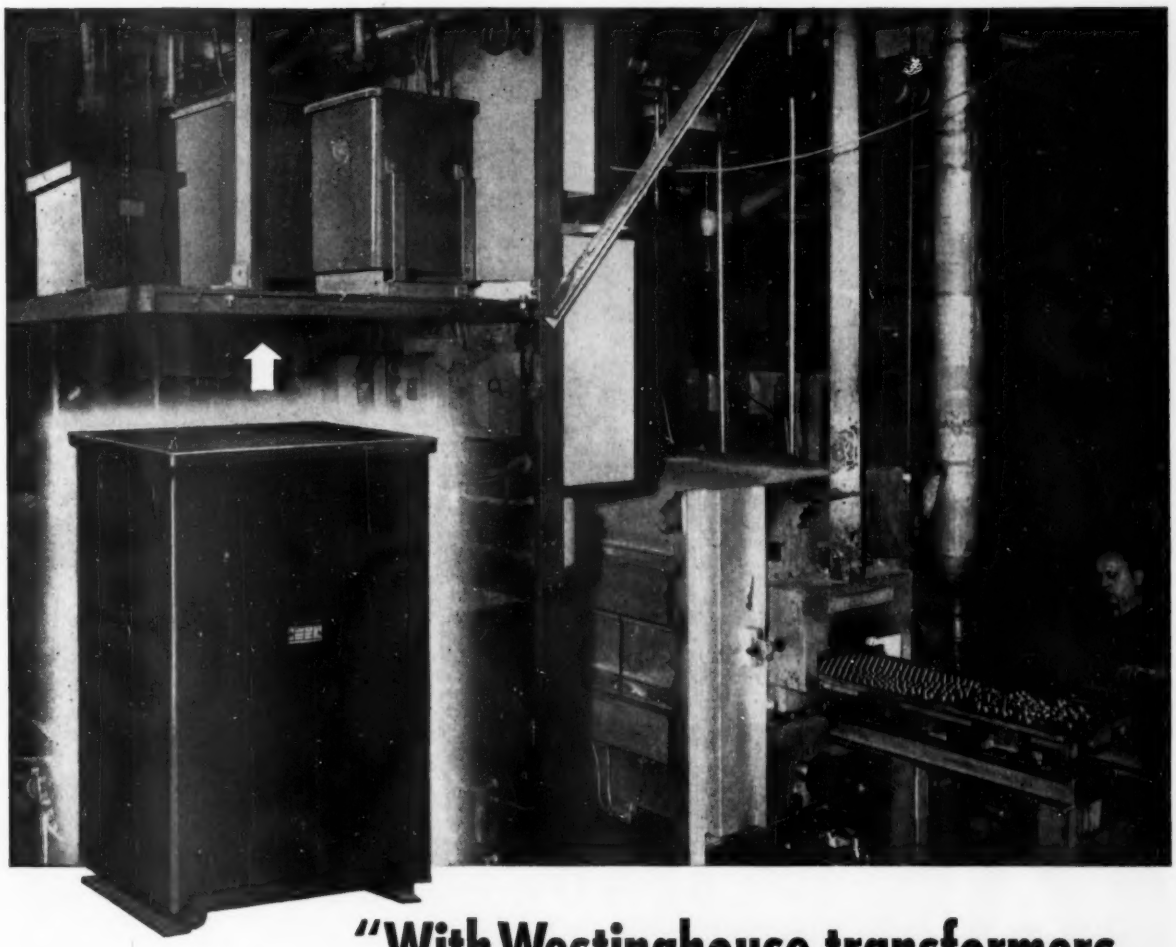
NISA Shop Celebrates 50th Anniversary

The New England Machine & Electric Company, Pawtucket, R. I., recently held "open house" for its customers, friends and suppliers, in observance of its completion this year of 50 years of service to industry. Founded in 1903, the firm has pioneered in electrical construction and motor repair work through the years.

Founder of the firm was Frederic W. Smith who, in 1903, formed his own electrical company and entered into a partnership with Arthur Sisson, machinist, to set up the firm name which is still in use. In 1907 the partnership was dissolved and the firm became a corporation with Mr. Smith as president and treasurer, which position he held until his death in 1942.

In a new location not far removed from the original basement shop, the firm now embraces an electrical construction department, a complete motor repair service, and an electrical supply business. In 1945, the company also opened a branch in Westerly, R. I., as a convenience to its growing list of customers in western Rhode Island and southern Connecticut.

From the firm's beginning it has been active in electrical construction work of all kinds. Its electrical crews have wired most of the important textile mills and other industrial plants in Rhode Island. As it built up its reputation for quality workmanship, it was awarded electrical construction contracts in other New England states, including Connecticut, Massachusetts and Maine. During the first two decades of the company's history electrical construction accounted for a major part of its business.



"With Westinghouse transformers we don't worry about costly shutdowns!"

A heat-treating furnace located in a crowded production area at Marlin-Rockwell Co. needed economical and reliable power close to the load. Mr. Merville Pineo, Engineer in charge of maintenance, made this statement—

"Any transformer failure would be extremely costly to us, inasmuch as it would shut down the furnace. We've had no power breakdown with Westinghouse transformers. I have a high regard for Westinghouse transformers because of their dependability and minimum of maintenance requirements. During routine checkups, we've found they're easy to get into . . . and you'll never find a maintenance engineer who will complain about that!"

On-the-spot power was possible with Westinghouse dry-type transformers because they are small and light enough to be mounted on an overhead platform. Long, high-cost secondary runs are eliminated—valuable floor space saved.

Westinghouse dry-type transformers may solve a problem of yours—at impressive savings in installation and maintenance. Call in your Westinghouse representative—he'll be glad to talk with you. Or write for booklet B-5812, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-70667

YOU CAN BE SURE... IF IT'S

Westinghouse

Prevent Costly Burnouts

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VAP-OIL-TITE FITTINGS

Fouled contacts cause costly burnouts and down-time. Use VAP-OIL-TITE FITTINGS with Plastic Covered Flexible Metallic Conduit for Sure Sealing of wiring on oil, water, dust and vapor tite equipment.

VAP-OIL-TITE'S exclusive threaded bushing not only insures positive grounding but also makes fitting easier to install because a collar covers metal edges making burring unnecessary. Furnished in numerous types with body sizes from 3/8" to 2". Write or wire today for bulletin #MT-104 giving types, sizes and prices.

SIMPLET ELECTRIC COMPANY
3600 Potomac Ave., Chicago 51, Illinois
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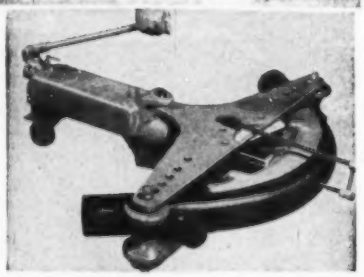
TAL PORTABLE BENDERS

BEND THINWALL or RIGID CONDUIT FASTER

These Electrical Contractors, from all over the country, tell us their biggest jobs are installed without manufactured ells. Everything is bent at considerable savings because *only* TAL "ONE-SETTING" BENDERS are used:

- **EDW. P. ALLISON & CO., Chicago, Illinois**
- **EVANS ELECTRICAL CONSTRUCTION CO., Kansas City, Missouri**
- **HATFIELD ELECTRIC CO., Indianapolis, Indiana**
- **MAGAW ELECTRIC CO., Milwaukee, Wisconsin**
- **MILLER ELECTRIC CO., Jacksonville, Florida**
- **SANBORN ELECTRIC CO., Indianapolis, Indiana**

YOU, too, can earn bigger profits by reducing up to 80% the number of elbows and couplings otherwise needed.



Save on cutting, threading and installing. With a *Tal Portable Bender* you can make any degree bend in ONE SETTING WITHOUT SHIFTING THE CONDUIT.

Portable hydraulic benders for rigid conduit to 5" and thinwall conduit, 1"—2" . . . Small combination hand-operated bender for both rigid and thinwall conduit, ½"—¾".

WRITE FOR THIS FREE BULLETIN

Tal Bender, Inc. Dept. 23 Milwaukee 2, Wis.

TAKING ADVANTAGE of a session break at Minneapolis conference, electrical contractor Leonard Lien, Worthington, Minn., visits with Harold H. Hanson, Mid-Sota Electric and Plumbing Co., Wadena, Minnesota.

Guiding the destiny of New England Machine & Electric Company today are three young top officers who have jointly served a total of 80 years in the business. Alfred Elson, Jr., secretary of the firm since 1927, became president and treasurer in 1942, when Mr. Smith died. In this capacity he handles all financial affairs and service policies, and supervises the inside shop work of the motor repair departments and machine shop. Alfred H. Sparn is vice-president, and supervises the electrical construction department which today accounts for about two-thirds of the company's business. Walter L. Kelley, Jr. is also vice-president, and supervises sales, including those for the New England Electric Supply Company.

The 50-year history of New England Machine & Electric Company is one of continued growth and expansion. It is a tribute to its founder's farsightedness back at the turn of the century, and to his faith in the future of electricity. Because of his insistence on quality workmanship and reliable service, the firm's reputation was on solid footing from the start. New England Machine & Electric Company's officers and employees are carrying on a great tradition of which they and the electrical industry may well be proud.

New Electrical League Formed

The Electrical League of Lynchburg was formed in Lynchburg, Va. early in August, during an organizational dinner meeting held for that purpose. In attendance were representatives of

Meet all electrical "specs" with Youngstown Buckeye Conduit!

CONTRACTOR TELLS WHY HE'S FOR BUCKEYE: "When wiring homes, I refuse to take short cuts. That's why I use Youngstown Buckeye rigid steel conduit. That's the conduit approved for all types of building construction and occupancy—for tomorrow's demands as well as today's. Buckeye gives wiring complete protection. Home owners like to know that."

LISTEN TO THIS CONSULTING ELECTRICAL ENGINEER: "Only full weight standard threaded rigid steel conduit is approved by the Code as moisture, dust and explosion proof for use in hazardous locations. That's why I always specify Youngstown Buckeye conduit. In addition, I find that the strength and permanence of Buckeye conduit is appreciated by builders."

Youngstown manufactures full weight standard threaded rigid steel conduit from start to finish. This assures better steel and consistency of quality in manufacture. Only top grade steel gives complete long term protection. When you buy or specify Youngstown Buckeye conduit, you know you're meeting all construction requirements.

Shipments of Buckeye rigid steel conduit are now being made from our conduit mills at Indiana Harbor and Youngstown.

QUALITY YOUNGSTOWN SERVICE

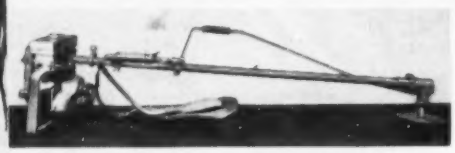
THE YOUNGSTOWN SHEET AND TUBE COMPANY General Offices — Youngstown 1, Ohio

Manufacturers of Carbon, Alloy and Yoloy Steel Export Office-500 Fifth Avenue, New York

COLD FINISHED CARBON AND ALLOY BARS · ELECTROLYTIC TIN PLATE · COKE TIN PLATE · WIRE · PIPE AND TUBULAR PRODUCTS · CONDUIT · RODS · SHEETS · PLATES · BARS · RAILROAD TRACK SPIKES

This Booklet Shows You How Your Company Can
SAVE 83% ON BRUSHCUTTING COSTS!

with amazing, power-driven
BRUSHMASTER®
THE SAFE, EFFICIENT METHOD OF MAINTAINING RIGHT-OF-WAY CLEARANCE



ONE MAN ACCOMPLISHES THE WORK OF 6 HAND-CUTTERS!

Hundreds of American industries are showing big savings with the Brushmaster Saw. It cuts brush from matted grass to saplings 4" in diameter or over, including vines, honeysuckle, thorns, etc. It's *safe* . . . operator can not come into contact with saw blade! It's *mobile* . . . goes anywhere a man can walk . . . operates freely from right to left, close to ground or overhead! Vibration-free, clutch-controlled, positive drive.

FREE! This colorful booklet tells how machine magic has made all previous methods of brushcutting obsolete. Send for it today.

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97 EMERALD ST., KEENE, N. H.
Subsidiary of *Harrington & Richardson, Inc.*, established 1871.

Manufactured and sold in Canada by H&R Arms Co., Ltd., Montreal, Canada

For Durable Installations . . .
USE G-E METER SOCKETS
- **Baked-on aluminum Glyptal® for long life.**
- **Tin-plated bronze terminal clips for low-resistance contact.**
- **Stainless-steel ring to reduce corrosion.**

Contact your nearest G-E sales representative or write General Electric, Schenectady 5, N. Y. 601-90

There's a G-E Meter Socket for Every Application.

GENERAL ELECTRIC

OFFICERS for the newly formed Lynchburg (Va.) Electrical League are: L. R. Lipscomb, Lipscomb Electric Co. (right), president; Vernon B. Goff, Goff Electrical Co. (center), vice-president; and Earl R. Driskill, Appalachian Electric Power Co., secretary-treasurer.

the various groups in Lynchburg having an interest in any or all of the local electrical activities of that area.

Chairman for the organizational meeting was William R. White, manager, Virginia Chapter, National Electrical Contractors Association, Inc., of Richmond, Va., who is also active in the Electrical Leagues of Richmond, Alexandria, and Norfolk, Virginia.

Guest speaker for this meeting was Berlon C. Cooper, Eastern Editor, *Electrical Construction and Maintenance*, who discussed the desirability of cooperative effort to promote the electrical industry and stressed the importance of the electrical contractor in such activity.

It was voted unanimously to form the Electrical League of Lynchburg, to provide an association of the electrical industry in that area which will promote the best interests of the industry and take an active part in all local electrical programs and activities.

The newly formed league elected officers for the first year as follows: L. R. Lipscomb, Lipscomb Electric Co., president; Vernon B. Goff, Goff Electrical Co., vice-president; and Earl R. Driskill, Appalachian Electric Power Co., secretary-treasurer.

A five-man board of directors was elected to provide guidance to the League's activities. Members of this board are: F. M. Cloyd, Appalachian Electric Power Co. (utility); Harry Haga, Harry Haga Co. (appliance dealers); H. C. Hubbard, Hubbard Electric Co. (electrical contractors); L. M. McGhee, Mid-State Electrical Supply Co. (electrical distributors); and G. M. Perry, Wiley and Wilson (consulting engineers).

Special tribute was paid to H. C. Hubbard, electrical contractor, for his efforts and initiative in stimulating interest with his fellow contractors and others in the formation of this new venture in electrical cooperation in Lynchburg.

Now... set fastening studs wherever they're needed
MODEL 450 REMINGTON STUD DRIVER
Here's new economy . . . new speed in construction fastening! The Remington Stud Driver joins wood or steel sections to concrete or steel surfaces in seconds . . . easily sets as high as 5 studs a minute. Powerful 32 caliber charges drive studs arrow-straight. The tool's light weight—only 5½ pounds—simplifies handling wherever studs are needed.
New guards for specific uses now make the self-powered Remington Stud Driver more versatile than ever. These attachments take all the guesswork out of stud location . . . assure fast, accurate fastening for every job. Illustrated are just 4 of these special guards. For full information about the complete line and about the Remington Stud Driver, send the coupon below.
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Please send me my free copies of the new booklets showing how I can cut my fastening costs.
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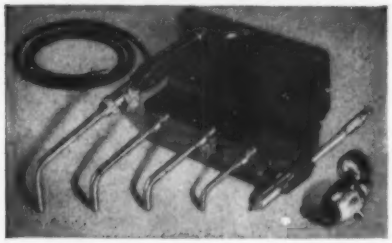

PREST-O-LITE *Torches average less than 12 in. long, weigh under 13 ounces. Precisely controlled flame heats only the work.*

With the four different sized stems and soldering iron in this outfit, you can handle any job from the heaviest soldering down to finest instrument work. The stems and soldering iron are instantly interchangeable on a common handle. No wrench is needed. Every assembly is small, compact, light, and easy to handle in any location. See your LINDE Jobber today for details. Or write LINDE AIR PRODUCTS COMPANY, a Division of Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y. In Canada: Dominion Oxygen Company, Limited, Toronto.

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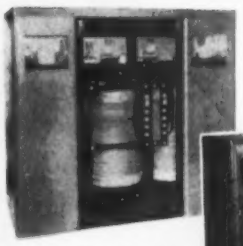
The term "Prest-O-Lite" is a registered trade-mark of Union Carbide and Carbon Corporation.

Want the Better* TRANSFORMERS?

We build them . . . with modern materials and engineering techniques . . . plus up-to-date design . . . based on years of experience.

Here is a typical air-cooled 500 KVA class B type. 80°C Rise. 3 phase 4160 Delta Primary ± 2½% full capacity taps. 240x480 Delta Secondary. Available from 30 to 2500 KVA with voltages from 2400 to 15 KV.



Open

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Distribution Transformers (Dry Type)

* If you think this is just an advertising adjective we invite you to contact us—we will tell you who buys Magnatran—the better transformers . . . and if you want, show you how we build them.

DRY TYPE
Indoor or Outdoor (3 KVA to 15 KVA Air-cooled)

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Meets Standards of AIEE-NEMA

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TRANSFORMERS AND ELECTRICAL EQUIPMENT
Walter Garlick, Jr., President
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WRITE FOR DETAILS

A NAME SYNONYMOUS WITH EXPERIENCE

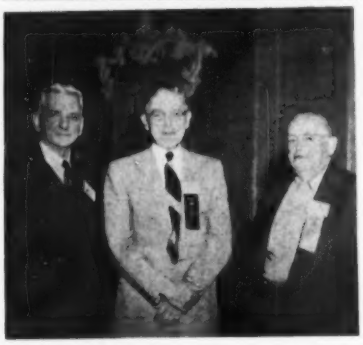
Cooperative Promotion Program Launched by Anaconda for Contractors

"Full Power Ahead" is a cooperative promotion program developed by Anaconda Wire & Cable Company as a contribution to the electrical industry's counterattack against obsolescent wiring. The program has been worked up to benefit electrical contractors, electrical distributors and utilities "to promote and provide for extended use of electricity on the farm, in the home, in small industry, and in commercial enterprises."

Anaconda says there is a multi-billion dollar wiring modernization market ready and ripe to be divided among alert, aggressive electrical contractors. Conservative estimates of average expenditures for rewiring private homes place the average-per-job at better than $100, and the average for industrial and commercial wiring modernization runs into four figures.

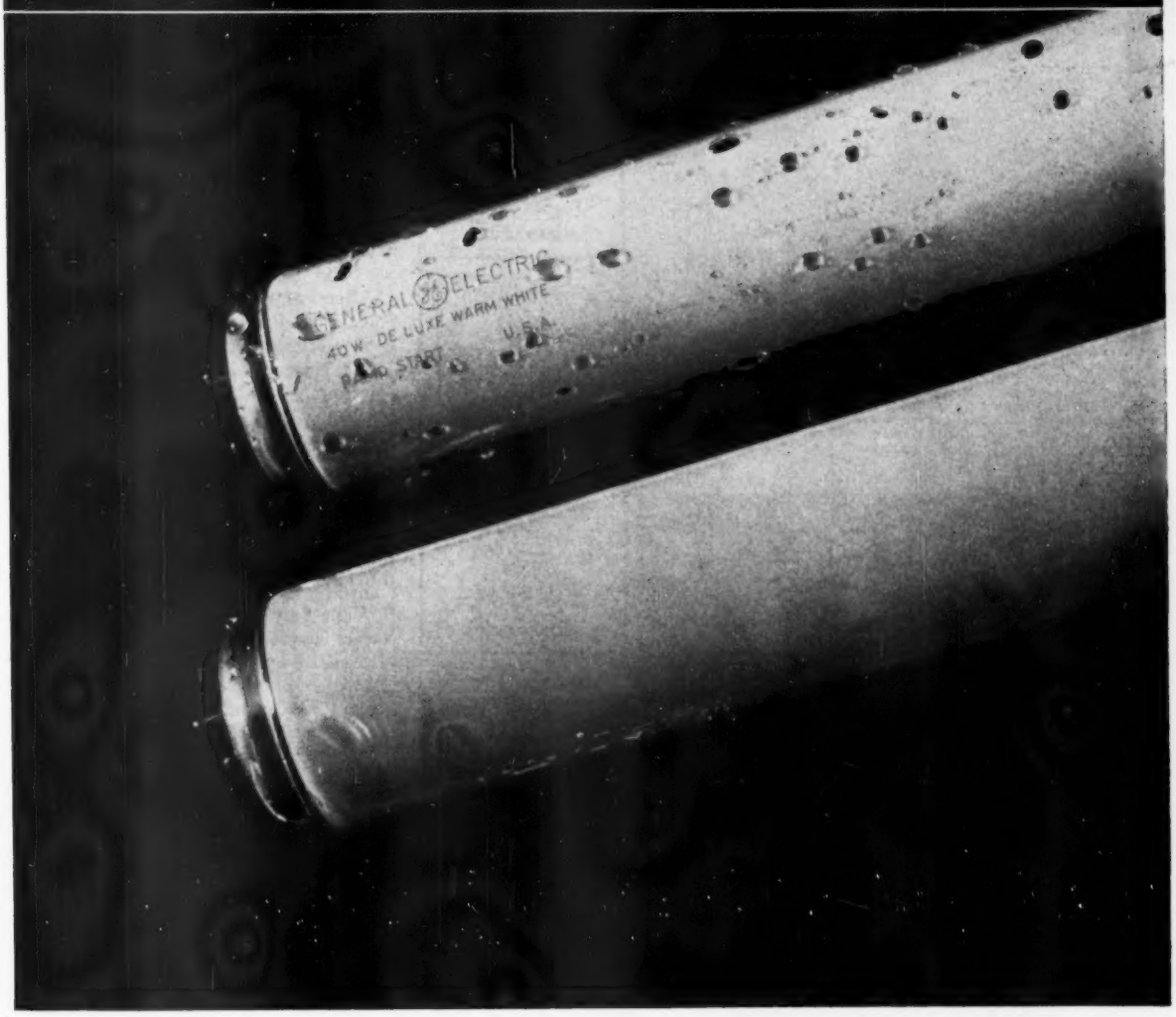
A "tool kit" contains everything the contractor needs to build home rewiring, farm rewiring and industrial and commercial rewiring business, including the "How to do it".

The brochure shows the simple, step-by-step way each group—contractors, distributors and utility companies—can organize cooperatively in the interest of better business all around, including necessary information on how to finance wiring modernization work by property improvement loans insured under "Title I" of the National Housing Act; direct mail samples, etc. The only expense to users is postage on three mailings going to the target groups. Also included are instructions on ordering, imprinting and mailing campaign literature with suggestions on compiling lists and following through on inquiries.



J. K. SCRIMGEOUR, Scrimgeour Electric Co., Worcester, Mass.; M. L. Schmitt, Springfield, Mass.; and M. J. Doyle, Scrimgeour Electric Co., attended the NECA District No. 1 convention at Groton, Conn.

You expect the best value from G-E fluorescent lamps



Silicone coat on new G-E Rapid Start lamps helps them start quicker

Moisture in the air can make a fluorescent lamp slow to start. The wet film that condenses on the lamp is a good enough conductor to detour some of the electricity needed for proper starting.

General Electric has tailored a "raincoat" that stops this. It's made of silicone and breaks up the wet film into tiny droplets, leaving dry areas that interrupt the electrical contact. Less current is stolen. Starting is quicker, surer.

We call the coating Dri-Film*. The photo above shows the difference it makes. Moisture breaks up into droplets on the Dri-Film* lamp, forms a smooth coating on the ordinary lamp.

You get Dri-Film* on G-E Rapid Start lamps. It's invisible, won't rub off, helps assure you all the light you pay for. Many leading manufacturers have designed lighting fixtures to use Rapid Start lamps and their special Rapid Start ballasts. You *expect* the best value from G-E fluorescent lamps. Here's another reason you can.

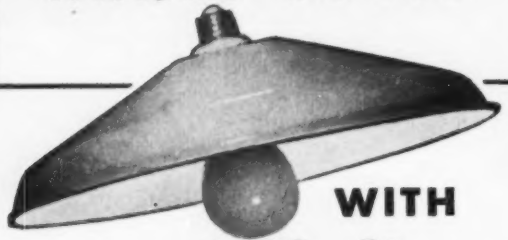
For more information, write General Electric, Department 166-EC-9, Nela Park, Cleveland 12, Ohio.

*Reg. U. S. Pat. Off.

You can put your confidence in—

GENERAL ELECTRIC

PROTECT ALL
"NAKED BULBS"



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For better, safer, more economical overhead lighting, protect all "naked bulbs" with Jiffylite . . . *the newest lighting idea in years!* Jiffylite Reflector has a 2 piece plug and socket; lamp screws into Jiffylite, Jiffylite screws into outlet. Eliminates danger of accidental lamp breakage. Permits use of lower watt lamps because the Titanium "whiter than white" inside finish reflects *all light* from the lamp. Lifetime porcelain enamel inside and outside . . . fused to sturdy steel shell. Available in 10 inch and 12 inch diameters. Order Jiffylite Reflectors from your jobber; write direct for folder.

WHITER THAN WHITE
ABOLITE Lighting

THE JONES METAL PRODUCTS CO. • West Lafayette, O.

LOCK CABLE SAFELY, SECURELY *with*—
"EFFICIENCY" Cable Strain Clamps
without Strain or Damage

. . . withstands direct pull of 17,000 pounds

Efficiency Cable Strain Clamps lock cable safely and securely without possible strain or damage. "H" construction of clamps and high ridge across center of cable prevents cable from slipping. Takes cable from 1/0 to 1,500,000 c.m. Three clamp sizes cover all cable sizes. Furnished with eye or clevis, for AC or DC service.

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Efficiency
ELECTRIC AND MANUFACTURING CO.
MANUFACTURERS OF EFFICIENCY ELECTRICAL DEVICES FOR CONDUIT, WIRE AND CABLE SUSPENSION
EAST PALESTINE, OHIO
"EFFICIENCY" DEVICES FOR CONDUIT and CABLE SUSPENSION

1953 Electrical Code Approved by ASA

The American Standards Association, on August 7, announced approval of the 1953 Edition of the National Electrical Code as an American Standard. ASA designation for this Standard is C1-1953 and the Universal Decimal Classification number is UDC-614.825.

The approval of this Standard reflects its preeminent position in the field of American Standards and proves the worthiness of the effort towards uniformity in the pursuit of safety regulations.

The 1953 edition of the National Electrical Code will be published by National Fire Protection Association, 60 Batterymarch St., Boston, Mass., and National Board of Fire Underwriters, 85 John St., New York City.

Construction Contract Awards Rise in July

The lagging construction boom has taken a one-month sprint that will bring activity in the months ahead, according to F. W. Dodge Corporation.

The July total of construction contract awards in the 37 eastern states as added up from the Dodge Reports were the highest of any month this year. The grand total was $1,793,342,000, compared with $1,115,509,000 in June and $1,511,285,000 in July 1952.

Contributing to the July rise were the highest monthly awards for commercial buildings and for educational and science building ever recorded since Dodge started to compile construction statistics in 1919.

Even the residential classification which had shown weakness for some time came up with $653,407,000 reported. This was the second highest residential month this year, surpassed only by April with $673,887,000.

The nonresidential building total of $764,393,000 contained awards of $200,133,000 for commercial buildings; $176,418,000 for educational and science buildings, and $206,702,000 for manufacturing buildings.

Heavy-engineering totaled $375,542,000, almost double the preceding month's figure of $193,195,000 and about 10% greater than the $340,521,000 recorded in July 1952.

July brought the Dodge seven-month total to $9,701,180,000, up 5% over seven months of 1952. The seven months totals by classifications were: nonresidential, $3,716,424,000 or 14% above seven months of 1952; residential, $3,911,903,000 or 1% less; and heavy-engineering, $2,072,853,000, up 1%.

How to speed wiring jobs with 2020 connectors

T&B ENGINEERED

With T & B 2020 connectors you can substantially reduce the time it usually takes to wire boxes and hook up portable cords using ordinary locknut-type connectors.

Just an easy finger squeeze — that's all it takes to snap a T & B 2020 connector into the box. Deep body grooves hold the connector in ½-inch knockouts while the one-screw tightening clamp grips the cable tightly without damage to insulation — there are no loose parts to handle . . . no locknuts to lose.

The wide-range adjustability and smooth, firm grip of the T & B 2020 connector cable clamp makes it ideal for use on portable cords and small-diameter, plastic-sheathed cables as well as standard non-metallic sheathed cable in sizes 14-2 to 10-3; 2 or 3 wire. The 2020 connector is fully approved by the Underwriters' Laboratory. For complete details send for descriptive folder.

T & B 2020 CONNECTOR
(for non-metallic sheathed cable)

Installs from **OUTSIDE OR INSIDE** a junction box.

Designed for installation from either *inside or outside* of the box, the patented T & B 2020 connector is particularly well-suited for work in old buildings. Working from the inside eliminates much of the damage often done to adjacent floors or walls . . . you keep costs to a minimum.

T-32

LOOK FOR THIS SIGN — T&B ENGINEERED

IT'S THE MARK OF AN AUTHORIZED T & B DISTRIBUTOR

The complete line of T & B fittings for conductors and raceways is sold only by recognized electrical wholesalers. It's our way of assuring you the service and savings of a friendly local source. Call him for all your electrical needs.

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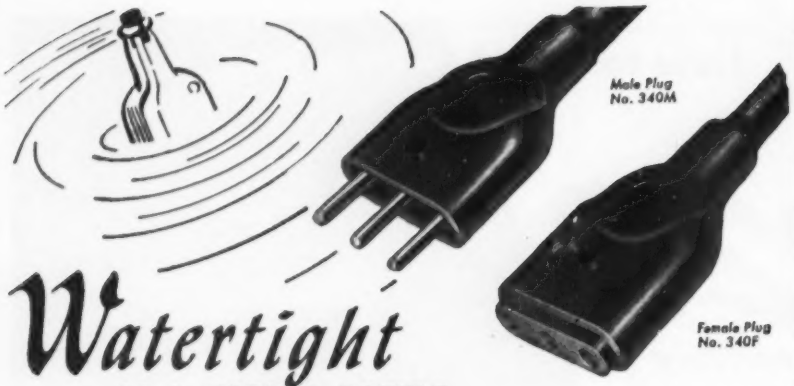

Watertight
AS A CORKED BOTTLE

Moisture cannot penetrate the one-piece Neoprene body of a JOY electrical plug . . . when engaged, even its contacts are enclosed in a protective Neoprene housing through the *cork-like* action of JOY'S famous water-seal. Permanently vulcanized to cable, it cannot crack . . . won't lose its shape . . . and requires no special considerations to insure a long life of useful service. A favorite since '26, JOY electrical connectors are now available in styles and sizes for nearly any portable electrical power transmission need. Why risk electrical misfits when the best actually costs less, in the long run? Write for full details including literature today!

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M.E. 152.1

Another NEW *Addition*
to the
INTER-MATIC®
TIME SWITCH FAMILY

SERIES T670—for
Timings of 5 to 60 Minutes

EXCLUSIVE

Each "on-off" cycle can be independently set for any timing from 5 to 60 minutes.

- *Snap-out mechanism*
- *Easy-to-set dial—pull forward and turn*
- *Front-mounted motor for visual observation*
- *1 to 12 trippers on the same dial*
- *Easy to install—extra room for wiring*

FOR THE FIRST TIME . . . a time switch that provides multiple "on-off" cycles—each independently adjustable for settings of from 5 to 60 minutes . . . AND . . . from 1 to 12 "on-off" operations a day—every day! It's the NEW Inter-Matic Series T670 Time Switch.

Ideal for control of Industrial process timing, commercial refrigeration defrosting, motors, ventilating systems, fans, lawn sprinkler systems, automatic poultry feeders, and other equipment requiring intermittent operation of one hour or less. Set the switch to operate 5 minutes in the morning—20 minutes at noon—45 minutes at night . . . or any other combination, all on one time switch.

Write for complete details—ask for Bulletin No. 93-B
Other models available in a complete line.

INTERNATIONAL REGISTER COMPANY
2624 West Washington Boulevard, Chicago 12, Illinois

INTER-MATIC® TIME SWITCHES

Employment Sets Record

More Americans were working in August than ever before and fewer were unemployed than at any time since the end of World War II, the Department of Commerce has reported.

It said August employment reached a record 63,408,000, and unemployment declined to a postwar low of 1,240,000, a level that officials considered close to a bare minimum.

"Only 1.9% of all civilian workers were out of jobs this August as compared with 2.5% a year ago," commented Robert A. Murray, acting Secretary of Commerce. "Thus, with a current labor force of 65,000,000, unemployment is barely over the one million mark."

The figures showed 308,000 more people working in August than in July, due to a pick-up in commercial and industrial hiring, which more than offset a seasonal decline in farm employment.

Employment in factories, stores and other businesses climbed to 56,134,000 from the 55,492,000 estimated in July.

The previous postwar unemployment low was as 1,284,000 in October, 1952. In August last year the figure was 1,604,000.

On the other hand farm employment dropped to 7,274,000, about 250,000 under the July total and 650,000 below the June peak.

NISA News

The 15th Annual Convention of the Southeastern Chapter will be held Oct. 22-24 at the Henry Grady Hotel, Atlanta, Ga. J. Arthur Turner Jr., Tampa Armature Works, Tampa, Fla. has been appointed program chairman. L. deLoache, Cleveland Electric Co., Atlanta, is chairman of the publicity and printing committee, and T. L. Thompson, Bearden-Thompson Electric Co., Atlanta, is in charge of advance registration.

• • • •

King Coal Chapter moved into St. Louis territory for its July 15th meeting, touring the St. Louis Post-Dispatch building in the early afternoon before moving across the street to the Hotel Jefferson for a business meeting. Dinner for members, wives and guests was held at the S.S. Tahiti, a restaurant in St. Louis County, after which the group attended St. Louis' famed outdoor Municipal Opera.

• • • •

One would think the New York Metropolitan Chapter would take a

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Reserve Power—for the extra-tough job. Powerful, Continuous-Duty Motors—built in PET's own factory. Dynamically Balanced Armatures—for freedom from vibration.
Six Heavy-Duty Ball and Needle Bearings.
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If you want the *best* for your maintenance or production work, take an extra look at the PET Superduty Drill shown here. Check its features! Here's a drill that's made for heavy, continuous duty... with *plus* power per pound . . . built to *work* right and *handle* right on the job.

Normally you might expect to pay extra for such features—in the form of "optionals" that jack up your cost. But that's not true of PET Drills! All these features are standard in the PET Superduty line . . . *and they're available to you at a standard drill price!* That's why the coupon below can save money for you. For free catalog and name of your nearest PET distributor, *mail it today!*

NOW...you can get the RIGHT DRILL for YOUR job!

PET Superduty Drills are available in 54 distinct models and 3 capacities: ¼", ⅜" and ½". Your choice of pistol or saw-type grip. With such a broad line, you don't have to compromise on a drill that's "almost" right! You can choose *exactly* the drill you need for your job. The PET Superduty line includes drills meeting U. S. Government and military specifications.

PET® POWER TOOLS

Plus Power per Pound

PORTABLE ELECTRIC TOOLS, INC.

320 West 83rd Street, Chicago 20, Illinois

In Canada: Portable Electric Tools, Ltd., 452 Birchmount Road, Toronto 13, Ontario, Canada

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Gentlemen: Please send us free copy of your PET Superduty catalog, and name of nearest distributor.

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*Company*_____

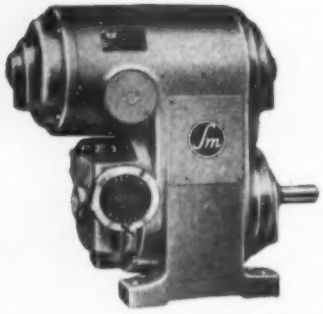
*Address*_____

*City*_____ *State*_____

Jantzen Increases Production 25% With Sterling Speed-Trols

We consider Speed-Trol Variable Speed Drives indispensable to the progress of the spinning industry, reports C. A. Fischer, Maintenance Engineer of Jantzen Knitting Mills, Inc. Since installing Speed-Trols on spinning frames and various other machines at Jantzen, production has increased 25% to 30% and maintenance costs have been reduced.

STERLING SPEED-TROL



GIVES YOU VARIABLE SPEED CONTROL NECESSARY FOR:

Equipment adaptation to: Sequence synchronization — operators' abilities — load variations due to differences in quantity, quality, weight, size, tension, hardness or shape of material to be processed, machined, conveyed, blended, mixed, etc.

Process control of: Temperature—viscosity—level—pressure—flow—etc.

Time control of: Baking—drying—heating—cooking—pasteurizing—soaking—chemical action—etc.

With Speed-Trol you get the maximum in production, plant efficiency, quality & profit.

20-page illustrated catalog... Sterling Speed-Trol, Slo-Speed, Klosd and Klosd-Tite Electric Power Drives. Write for catalog No. A416

STERLING ELECTRIC MOTORS

Plants: New York City 51; Chicago, Illinois
Los Angeles 22; Hamilton, Canada; Santiago, Chile
Offices and distributors in all prineipal cities

GROUP FROM CONNECTICUT attending the NECA District No. 1 meeting at Groton, Conn., were (seated left to right) P. N. Keyes, Shelton Electric Co., Shelton, Conn.; A. J. Cappiello, Superior Electric Co., Bridgeport; J. M. McCormick, manager, Greater Fairfield Chapter, Bridgeport; (standing) C. J. Berner, Eastern Electrical Construction Co., Bridgeport; and K. Priestley, Bridgeport.

vacation after acting as host to the 20th Anniversary NISA Convention, but the group gathered June 18th at the Shelburne as usual for its regular monthly meeting. Discussions, naturally, centered around reports and comments on the May Convention.

• • • •

"No old business . . . No new business . . . No business" was the order of the day at New England Chapter's June 12th meeting in Providence, following celebration of the 50th Anniversary of New England Machine & Electric Co., Pawtucket, R. I. The chapter had dinner at Johnson's Hummocks, followed by entertainment.

• • • •

Cincinnati Chapter met June 25th for its annual golf-picnic meeting at the Twin Oaks Country Club. Southwestern Chapter has three new members: E. C. Saunders Electric Co., Carlsbad, N. M., Brandon & Clark Electric Co., Lubbock, Tex., and Lewis Electric Motor Service, Harlingen, Tex. Louisville Chapter met June 3 at the Mayflower Dining Room.

• • • •

Ontario Chapter with members of the Niagara Chapter as its guests, met June 13th at General Brock Hotel for dinner after having inspected the Sir Adam Beck No. 2 Generating Station. It was the first joint meeting the group has held with another NISA chapter.

• • • •

Niagara Chapter held its annual picnic June 20th at John Schlehr's ranch, Langford, New York with 60 members and guests present. The chapter's new president, Zip Lang,

Richards-Wilcox Electric Door Operators

for { Residential • Commercial / Industrial Installations

• *Convenient*
• *Practical*
• *Efficient*

For complete information, ask your jobber or write for R-W catalog A-87.

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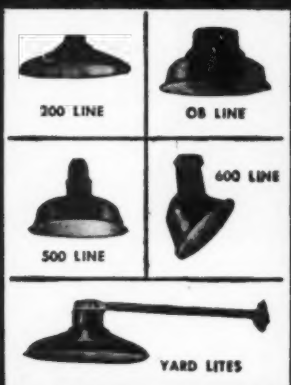
SPERO •Guaranteed PORCELAIN ENAMEL REFLECTORS

•Guaranteed equal to any standard specification



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CLEVELAND, OHIO

SORGEL AIR-COOLED Dry-Type TRANSFORMERS

Accepted—Top Quality—Time Tested

SORGEL dry-type transformers are preferred because of their cost-saving features and years of dependable service.

Easy installation—
Attached mounting brackets

Easy connecting—
Connection compartment with solderless terminals.

Rugged construction.

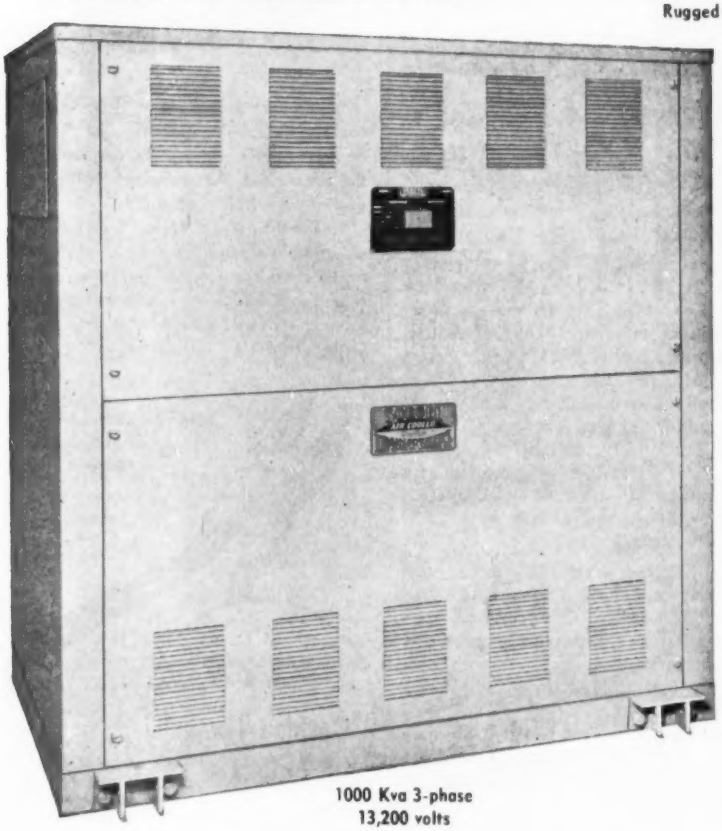
Totally enclosed in steel.

Liberal design.

High efficiency.

Low noise level.

Dependable.

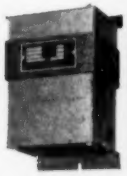


1000 Kva 3-phase
13,200 volts

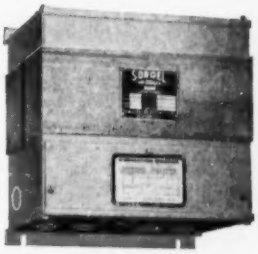
Complete Line

¼ Kva to 1500 Kva single phase.
1 Kva to 3000 Kva 3-phase, 2-phase and phase changing.

All standard voltages, such as 120, 208, 240, 480, 600, 2400, 4160, 4800, 7200, 13,200, up to 15,000 volts, and any intermediate or special lower voltages.



¼ Kva single phase 480/240 to 240/120 volts



1 to 10 Kva 3-phase

Sales Engineers in Principal Cities

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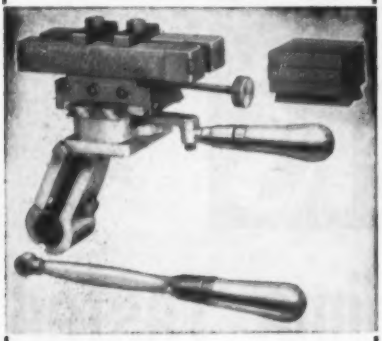
MARTINDALE

TYPE "C" COMMSTONE HOLDER



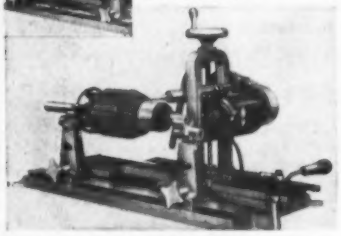
Holds Commstones rigid and true for concentric resurfacing of commutators and slip-rings while running at normal speeds in their own bearings. Grinds commutators up to 4¾" wide. Used with two Commstones in stone holder or one Commstone in 2" box.

BLOWERS and VACUUM CLEANERS

Available in 4 sizes from ⅓ to 1½ H.P. Suction attachments for all sizes. Write for information on other blowers.

BENCH-TYPE UNDERCUTTER

AT LEFT—Undercutting Vertical Commutator.
BELOW—Undercutting Horizontal Commutator. Note V-support at right raised to compensate for smaller shaft diameter.



Model HV-3 is a precision built, rugged, fast and accurate undercutter with a wider range of armature sizes and shaft lengths than any similar machine being built.

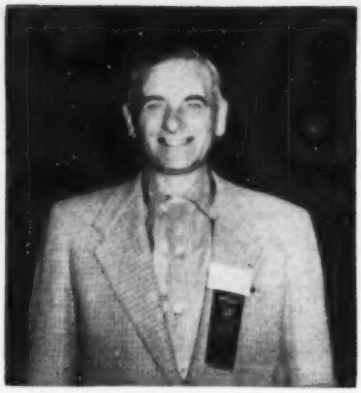
ADJUSTABLE BENCH GROWLER

Has adjustable jaws with face length of 2½". With jaws closed will test armatures as small as 1" diameter. With jaws open, will accommodate armatures as large as 18" diameter. Available with or without meter. Also six other models.

Write for New 64-page Catalog No. 29 describing these and many other products for Industrial Maintenance, Safety and Production

MARTINDALE ELECTRIC CO.

1309 Hird Ave. Cleveland 7, Ohio



HARRY HEYMAN, Standard Electric Co., Springfield, Mass., attended the annual convention of NECA District No. 1 at Hotel Griswold, Groton, Conn.

presented Fred Frosdick, Dynamo & Motor Exchange, Inc. with a bronze plaque "in appreciation of his devoted efforts to the betterment of the organization" for the last two years.

• • • •

Central District Chapter (Chicago) met June 9th at the Tower Club to hear M. H. Nelson, manager, resale division, Wagner Electric Corp., St. Louis, speak on "Increment Motor and Starter Combinations." The chapter held its monthly question-and-answer and for-sale-and-wanted sessions.

• • • •

Northern California Chapter met June 1st at El Jardin restaurant, San Francisco, with 12 members present. Three new committees were appointed. Executive, Keith M. Noble, chairman; Membership & Finance, Lloyd Flatland, chairman; and Program & Entertainment, Ken P. Moyle, chairman. The chapter met at the Athens Club, San Francisco, August 3rd and is considering holding its October meeting in Sacramento.

• • • •

Mid-South Chapter held its second quarterly meeting of the year June 27th at Knoxville. The group's morning session was devoted to discussions on advertising, outlook for copper, NEMA new frame sizes and warranty services. H. Ed. Grant was moderator. In the afternoon the group held its quarterly business meeting. The group's next meeting will be held in Chattanooga.

• • • •

North Central Chapter has re-elected its officers—president, Arch Lackore; vice president, Warren Mielke; secretary-treasurer, Bob Root, and is making plans for a September meeting in Duluth, Minn. Frank Ross, a NISA director, and Warren Mielke, are in charge of the program, which

"Third Hand" for cutting pliers!

It's simple but plenty effective! The *cushion* is tough, rubbery red Plastisol bonded right beside the cutting edge. As the pliers close, the *cushion* grips the short end of wire, holding it tightly.

The *"Cushion Throat"* is specially valuable in electronics work... makes cuts inside chassis without danger of wire snips falling into set. Grips spring or hard wire too—safety feature keeps wire from flying! Order from your distributor!

Only $1 list additional—applied to most UTICA diagonal or side-cutting pliers.

EXCLUSIVE UTICA PATENT

UTICA "Cushion Throat" Pliers

UTICA (when referring to hand tools) is a trade mark registered in the U. S. Patent Office.

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DROP FORGE AND TOOL CORPORATION
UTICA 4 NEW YORK

IT PAYS TO BUY QUALITY TOOLS
The world's best tools are made in U.S.A.

ATTENDING NECA District No. 1 meeting at Groton, Conn., were George E. Davis, A. L. Davis Co., Newark, C. P. Hansen, Peifer Electric Co., Trenton, and J. H. Friedland, Lighting Electric Service Co., Newark.

will include a trip to local iron mines and scenic spots.

• • • •

Clyde Pierson, Marion Electric Motor Service, Inc., Marion, Ohio is the new president of the Northwest-Central Ohio Chapter. Other officers who will serve with him during the coming year are: vice president, Andrew Benner, Modern Electric Service, Inc., Columbus; treasurer, Elmer Girkins, Girkins Electric Co., Toledo; secretary, Edward Johnson, The Fred W. Kiemle Co., Toledo; and assistant secretary, Ernest Kirschner, Whitney Electric Co., Toledo.

• • • •

A last-minute hole-in-one in the Nashville Banner's annual tournament by H. Ed. Grant, Tennessee Electric Motor Service, was the ex-NISA national president's first ace and the first in the newspaper's tourney since 1950.

Using an eight iron, Grant's shot, the 2011th fired by 671 golfers on the 110-yard Elmington Park hole, dropped just inside a 7½ foot circle painted on the green and rolled straight to the cup. It was his first of three shots, his second also landing on the green, while his third try was topped.

Only one other ex-NISA national president has a hole-in-one to his credit. He is Charles C. French, who scored his in Kansas City in 1927.

• • • •

Charles C. Warner, associated for many years with Northwestern Electric Co. Chicago, died June 21st.

Clayton O. Thiel, owner of Clayton's Electric Shop, Detroit, and a member of NISA's Great Lakes Chapter, died July 3rd. He is survived by his wife, Mrs Dorothy Thiel, and a son Clayton O., Jr.

• • • •

Empire Electric Co. Inc. has moved to its new building at 5200

Plan Now
FOR SAFE* ALL-ELECTRIC
ELECTROMODE HEAT

HARD-TO-HEAT AREAS
FACTORIES
OFFICES
ISOLATED BUILDINGS
PUMP HOUSES
METER HOUSES
WATCHMAN HOUSES
FACTORY OFFICES
LOBBIES
STORAGE ROOMS
GARAGES
HUNDREDS OF OTHER LOCATIONS

MORE PROFIT FOR YOU

- QUICK, EASY TO INSTALL
- MINIMUM MAINTENANCE
- 100% EFFICIENT
- USER SATISFACTION

***SAFE** Only Electromode has the completely sealed-in, cast-aluminum heating element. No danger of fire, shock or burn. Built-in safety switch prevents overheating.

***ECONOMICAL** All current entering the unit is converted into heat. There is no heat loss en route, like there is with long steam pipe runs. This system cannot freeze. The heating element will not rust, corrode or deteriorate. For utmost economy, can be thermostatically controlled.

COMBINATION PORTABLE and SUSPENSION type models, 1500 to 7500 watts (5,122 to 25,613 btu). Adjustable louvers permit directing heat into working zone. Model AN-30A illustrated.

SUSPENSION TYPE MODELS available from 10,000 to 45,000 watts (34,150 to 153,675 btu). Adjustable louvers permit directing heat into working zone. Model 14-10 illustrated.

EXPLOSION-PROOF HEATERS for heating hazardous areas subject to explosion. In three sizes: 2000, 4000, 6000 watts (6830 to 20490 btu). Model CX-2 illustrated.

AUTOMATIC WALL-TYPE HEATER with Down-Flo principle distributes clean, healthful, fan-circulated heat at floor level. Available from 1500 to 4000 watts. Model WA illustrated.

Approved by Underwriters' Laboratories

ELECTROMODE CORPORATION
Dept. EC-93, 45 Crouch Street, Rochester 3, N. Y.

Please send us your FREE Electric Heating File, containing specifications, illustrations, installations, prices and how to figure electric space heating.

We are interested in ☐ Electromode Industrial Heaters
☐ Electromode Home and Office Heaters
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Name .....
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Specify the

TROUBLE-FREE

3

For installations that will give years of satisfactory service, specify:

CLIFTON ARMORED CABLE

The flexible galvanized steel armor affords maximum mechanical protection for the moisture-proof, flame-retarding insulation which covers the conductors.

"CLIFTX" NON-METALLIC SHEATHED CABLE

Conductors are protected by five layers of insulating materials, with a rugged outer covering of moisture-resisting and flame-retarding overall braid.

CLIFTON FLEXIBLE STEEL CONDUIT

No waste—short pieces can be clamped together with couplings.

OTHER CLIFTON PRODUCTS include CLIFTON E.M.T., Rigid Conduit, and Pierceway Plastic Duct Wiring Systems.

WE MAKE NO BONES ABOUT IT . . .

CLIFTON PRODUCTS ARE THE BEST IN THEIR FIELD

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CONDUIT CO., Inc.

General Offices
75 Montgomery St.
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Factory: Baltimore, Md.

1st Avenue, Brooklyn, N. Y., occupying the entire building.

• • • •

The Flushing Electric Corp., 45-07 162nd Street, Flushing, New York has been named a certified service shop for Allis-Chalmers motors, controls and transformers in southeastern New York state, serving the counties of Queens, Suffolk, Nassau, Kings, Bronx, New York and Westchester.

• • • •

The following Publication and Publicity Committee was reappointed by President Hogue to serve next year: Al. Elson, Chairman, New England Machine & Elec. Co., Pawtucket, R. I.; C. C. French, French-Gerleman Electric Co., St. Louis, Mo.; H. Ed. Grant, Tenn. Elec. Motor Service, Nashville, Tenn.; Walter J. Prise, The Maintenance Co., New York, N. Y.; and Frank W. Sloan, San Diego, Calif.

• • • •

A new list of NISA members is being prepared and will soon be available to all members.

From Walter J. Prise, The Maintenance Co., New York, N. Y.

Book Reviews

Control Systems

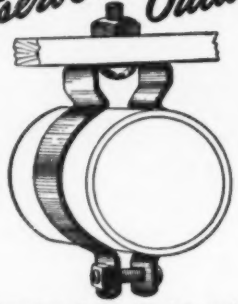
A much-needed link between the text contained in most of the books discussing electric machinery and those dealing with the more advanced analysis of feedback control is provided by R. W. Jones, professor of Electrical Engineering at Northwestern Technological Institute, in his book on Electric Control Systems. This book integrates the subjects of electric machinery, electronics, circuits and controls. Principles of motor operation are reviewed and analysed, while the characteristics of various control devices are projected up to the full scope of feedback control systems. The book is a practical combination of technical and non-technical material, with emphasis always placed upon the objectives of the controller. Relay switching networks are discussed in considerable detail, explained by algebraic examples.

Power amplifiers of both the dynamo-electrical and magnetic types are included, the concept of transfer functions is developed, problems associated with relay or binary switching circuits are presented for study, while the system aspects of electric control are emphasized. Nearly 200 problems, many requiring the design of a circuit to meet actual requirements for specific applications, are included, together with selected refer-

MINERALLAC

Steel **HANGERS, CLIPS, STRAPS**

Outserve! Outlast!



Minerallac Cable, Conduit and Messenger Hangers are STEEL. Easier, quicker to install; permit speedy, compact wiring; economical. Also in Everdur . . . Porcelain Insulating Bushings available.

• • •

Jiffy STEEL Clips (Pipe-clamp) require only one screw, nail or bolt; rib-strengthened; for hanging pipe, conduit, BX cable, mounting coils, etc. Millions in use.

• • •

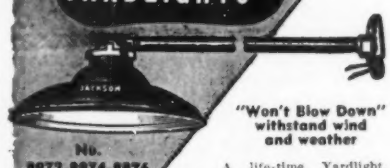
Steel Straps for Messenger-cable services on outlet boxes; may be used in conjunction with hangers.

• • •

Order from your Electrical Wholesaler. Send for literature.

MINERALLAC ELECTRIC COMPANY
25 North Peoria Street Chicago 7, Illinois

JACKSON
Porcelain Enameled
YARDLIGHTS



"Won't Blow Down"
withstand wind and weather

No. 8972-8974-8976

A life-time Yardlight. Modern design—one-piece heavy gauge steel finished with three coats of Vitreous Porcelain Enamel. Completely wired and assembled. Listed by U. L.—approved for R. E. A. installation. Send for catalog.

Small Adjustable
FLOODLIGHT

• Residential — Commercial—Industrial for permanent or temporary installations. Heavy gauge steel construction, baked enamel finish—7½" and 10½" dia. ref. — durable, tough, weatherproof. Universal adjustment—install on any flat surface or attach directly to 3½" or 4" outlet box. Approved 6-foot cord and plug.

• Available immediately at your Wholesalers.

JACKSON
ELECTRICAL COMPANY
900-910 W. Van Buren St., Chicago 7, Ill.

W. V. MERRIHUE, manager, Employee Relations Department, General Electric Co., New York, was one of the speakers at the convention of the New York State Association of Electrical Contractors and Dealers, Inc. at Saranac Inn, N. Y.

ences and an extensive bibliography.

A break-down of the contents shows that the book covers dynamics of the motor and the load, dc motor characteristics, ac characteristics, electromagnetic contact-making devices, gaseous electronic switching devices, electronic switching circuits, power amplifiers, control circuit fundamentals, basic motor control circuits, motor acceleration, rheostatic and switching methods for controlling speed, speed control with auxiliary power converters, motor braking, feedback control systems and motor protection.

The 511-page book measures 6-by-9¼-inches, contains 251 illustrations, is priced at $7.75 ($9.30 in Canada) and is published by John Wiley and Sons, Inc., 440-4th Avenue, New York 16, N. Y.

Engineering Fundamentals

A thoroughly revised second edition of the "Handbook of Engineering Fundamentals" by O. W. Eshbach contains contributions from 39 leading engineers and scientists and constitutes a one-volume technical reference for *all* branches of engineering. The scope of the book is indicated by reference to chapter headings, for they cover mathematics, physical units and standards, mechanics of rigid bodies, deformable bodies and compressible fluids, aerodynamics, thermodynamics, electricity and magnetism, radiation, light, acoustics, chemistry, metallic and non-metallic materials, and engineering law.

Not only does the handbook tabulate data in convenient form, but it is coordinated in such a manner that the

a **new** departure in design and appearance

200 or 300 WATT

SQUARE **RECESSED DOWNLIGHT**

- Square, silver-mirrored Permaflector, lamp and lens positioned for maximum efficiency with controlled brightness.
- Choice of extensive distribution, intensive distribution and drop bowl lens.
- Designer styled one-piece die-cast frame with concealed hinges and latch.
- Inconspicuous finger-pull for easy opening and maintenance.
- A readywired "packaged" unit with many labor saving installation features.
- Designed to recess into a 12" accoustical module.

Write for Specification Sheet

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404 OLIVER BUILDING, PITTSBURGH 22, PA.

FLUORESCENT "Pittsburgh" Permaflector *INCANDESCENT*

Lighting

REPRESENTATIVES IN PRINCIPAL CITIES • WHOLESALERS EVERYWHERE

PITTSBURGH REFLECTOR COMPANY

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Yes—I want to know more about the new silver-mirrored square downlights. Send Specification Sheet.

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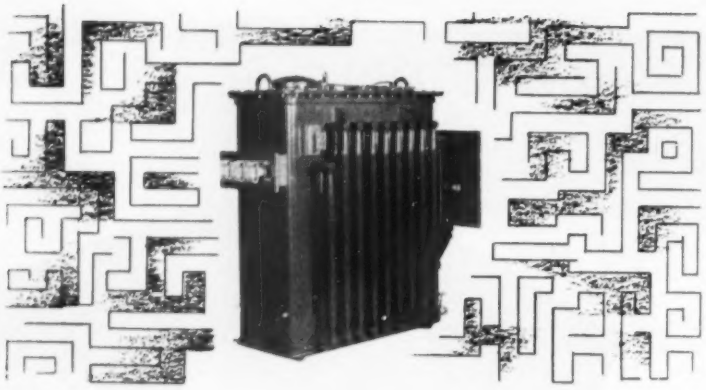

Let Standard Engineers untangle your transformer problems . . . .

IT'S NOT EASY to arrive at the solution to a particularly difficult transformer problem. However, when you have the able assistance of experienced STANDARD engineers the solution becomes easier and complete. Don't wrestle with your transformer problem any longer. Call STANDARD today!

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THE STANDARD TRANSFORMER COMPANY

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REPRESENTATIVES IN PRINCIPAL CITIES

HYDEE HANGER*

REDUCES INSTALLATION TIME

EASY, LOW-COST WAY TO HANG CHAIN-SUSPENDED FIXTURES

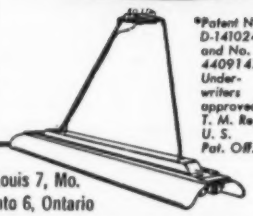
"DECIDEDLY BETTER"
DAY-BRITE
Lighting Fixtures

1. Connect wires to receptacle. Fits standard 4" or 3¼" outlet box or plaster ring.

2. Screw hanger to outlet box—only two screws needed. No centering, no punching, no drilling. Screwdriver only tool needed.

3. Hang the fixture and plug it in. That's all! Self-grounding—regular 2-wire cord and plug may be used.

Hydee Hanger, complete with receptacle, two 5-ft. chains, "S" hooks and clips—



*Patent No. D-141024 and No. 440914. Underwriters approved. T. M. Reg. U. S. Pat. Off.

Day-Brite Lighting, Inc., 5402 Bulwer Ave., St. Louis 7, Mo.
In Canada: Amalgamated Elec. Corp., Ltd., Toronto 6, Ontario

02

DISTRIBUTED NATIONALLY BY LEADING ELECTRICAL WHOLESALERS

important basic ideas in each category of reference is emphasized and illustrated.

Published by John Wiley & Sons, Inc. 440 Fourth Ave., New York 16, N. Y., the volume contains 1322 pages sized 5⅛ by 8⅛ inches, and 819 illustrations. The binding is semi-flexible and the books sells for $10.00 in the U. S.; $12.00 in Canada.

Metallizing

The application of metallized coatings for machine element work, for building up areas that have deteriorated through corrosion, and for many special production jobs are thoroughly detailed in a new handbook published for mechanics actively associated with this field. Profusely illustrated with photographs, diagrams and charts, the book provides a comprehensive coverage of the technical as well as the practical aspects of these processes. Covered in the treatise are such subjects as the repair of blowholes in castings, brazing and soldering, glass and ceramics, mass coatings in tumbling barrels, electric circuits and model work.

The handbook is published by Metallizing Engineering Co., Inc., Long Island City, N. Y. and includes 250 pages of text. Cloth-bound, the book is priced at $3.00.

Engineering Electronics

The second edition of William G. Dow's "Fundamentals of Engineering Electronics" contains many important changes. Step-by-step electron ray tracing methods are described; the analysis of the behavior of space-charge control tubes has been modernized, and the energy-level diagram study of the behavior of electrons in metals is extended. Transistors of the point contact and junction type are described; the current generator type of amplifier equivalent circuit is introduced, and analytical treatments of negative feedback and the cathode follower circuit is given.

Throughout the book the reader looks at electronics from the engineer's point of view. Principles of particular importance to the engineer are selected for study; illustrations of these principles are drawn from engineering practice, and physical concepts are so treated as to permit ready determinations of magnitudes.

Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., the book contains 626 pages sized 6-by-9¼ inches and is priced at $8.50 in the U. S.; $10.20 in Canada.

HOW TO ESTIMATE ELECTRIC HEATING LOADS

[FROM PAGE 11]

are installed in a zigzag pattern to provide the desired total watts capacity. The cables heat the surrounding plaster by conduction to a surface temperature in the ceiling of 100 to 120 degrees. In floor installations the surface temperature usually does not exceed 90 deg.

Wall Unit Heater

A large portion of contemporary electric space heating is provided by unit heaters recessed in the walls. Such units operate at relatively high element temperatures with capacities of 1 kw upward. Heat is distributed by natural convection or forced air circulation.

Glass Panel Heater

Glass panel heaters consist of a resistance element worked into a glass panel and designed to distribute a large fraction of the heat energy by radiation. They may be operated at approximately 300 deg. surface temperature and have an energy output of 1 kw upward. One or more panels are installed, usually recessed, in the lower wall area of sufficient total capacity to balance the maximum heat requirements.

Baseboard Unit Assemblies

Baseboard unit assemblies are a special design of heating unit which may be assembled to form a continuous baseboard. A typical unit operates at a surface temperature of 140 deg. Slots provide for convection air circulation through and around the heating elements. Approximate capacity is 160 watts per lineal foot.

Central Heat

Electric resistance elements may be installed in air ducts as furnaces, water heaters or steam boilers to serve conventional warm air, hot water or steam systems. Air duct heaters are sometimes used in conjunction with air conditioning systems for air tempering or to handle a moderate heating load. Electric steam boilers may serve ordinary space heating loads but they are more likely to be encountered where steam is required for process.

Since electric heating is so conveniently adaptable directly to the area to be heated, there is rarely an advantage in the use of an intermediate medium like air, water or steam for distribution of space heating energy through the building.

VOLTS and AMPS at a glance with the COLUMBIA

Complete with Voltage Leads and Carrying Case

A. C. TONG TYPE VOLT-AMMETER

• Quickly • Accurately • Safely

Columbia Type AC-1 provides ampere readings with a snap by merely clamping jaws around the electrical conductor, without breaking circuit or insulation. Voltage readings are taken quickly and easily with safety plug-in leads. This instrument is one of the Columbia line of tong type instruments of the highest quality and dependability.

TYPE AC-1 FEATURES

- Measures up to 600 Amperes and 600 Volts.
- Amperes: 0/12/60/120/-600 A.C.
- Volts: 0/150/600 A.C.
- Convenient Range Switch.
- Insulated Jaws will accommodate Conductors up to 1½" diameter, Bus Bars up to 2" x ½".
- Accuracy: 3% full scale.
- Light Weight—Fits Easily into Pocket.
- High Quality at Low Cost.

Inquiries Invited from Distributors • Write for Descriptive Bulletin AC-41

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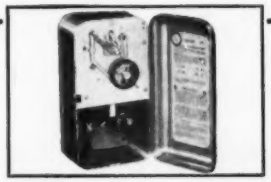
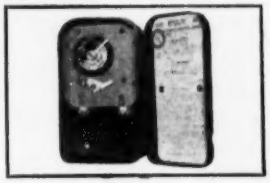
RELIANCE TIME SWITCHES

For Every Circuit Control Application



RUGGED 50 AMP. "BADGER"

Sturdily built switch designed for dependable control of heavy loads under severe operating conditions. Heavy gears, slow speed synchronous motor. Omitting device, optional.



VERSATILE 30 AMP. MODEL "W"

An extremely simple, compact switch in a variety of types including Type W-33, for 2-circuit control. Astronomic dials available in three types.

NEW 20 AMP. MODEL "400"

The new Reliance Model "400" has the features and quality of many higher-priced switches. Includes standard Reliance heavy duty motor, pit resistant silver-to-silver contacts.

RELIANCE TIME SWITCHES

1937 MEAD ST. RACINE, WISCONSIN

for the LONG PULL use
Y-ER EAS
Wire Pulling Lubricant

Only Y-ER EAS has all these features

Write for descriptive booklet

- Creamy, non-corrosive lubricant. Never greasy or messy.
- Prevents sticking or setting. Specially helpful on saddles and turns.
- Does not run back on cables.
- Never harmful to hands or clothing.
- Permanently non-harmful to cables or conduit.

GIVES THE SLIP TO-
Lead, Rubber, Braid or Synthetic Covered Cables

Improved Y-ER EAS tested and approved by the Underwriters' Laboratories, Inc.

AT ALL LEADING ELECTRICAL SUPPLY HOUSES

ELECTRO COMPOUND CO.
7818 W. 150th St., Cleveland 11, Ohio

Control MAXIMUM PRODUCTION
with G. S. SPEED INDICATORS and HAND TACHOMETERS

1% Accuracy for any range from 30 to 100,000 RPM or surface speed.

Antimagnetic durable mechanism.

Efficient repair service at moderate charges.

IDEAL FOR MOTORS — SHAFTS
SPINDLES — LOOMS — TURBINES
FOR TEXTILE AND POWER PLANTS

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DATES AHEAD

Illuminating Engineering Society — Hotel Commodore, New York, N. Y., September 14-18.

International Association of Electrical Inspectors — 25th Jubilee meeting. Edgewater Beach Hotel, Chicago, Ill., September 21-26.

Canadian Electrical Manufacturers Assn. — Annual meeting, General Brock Hotel, Niagara Falls, Ontario, Canada, September 23-25.

National Electronics Conference—9th Annual conference, Hotel Sherman, Chicago, Ill., September 28-30.

Second National Electrical Industries Show — Sponsored by the Eastern Electrical Wholesalers' Association, 69th Regiment Armory, 26th St. & Lexington Ave., New York, N. Y., September 29-October 2.

Industrial Electric Exposition — Hotel William Penn, Pittsburgh, Pa., October 6-8.

Electrical Progress Show—Convention Hall, 34th below Spruce Sts., Philadelphia, Pa., October 13-15.

New York State Apprenticeship Council—Conference at St. George Hotel, Brooklyn, N. Y., October 28-30.

National Electrical Manufacturers Assn.—Haddon Hall Hotel, Atlantic City, N. J., November 9-12.

National Electrical Contractors Association—Annual convention, Miami Beach, Florida, November 17-20.

National Rural Electric Cooperative Assn.—National convention, Miami, Florida, Jan. 11-14, 1954.

American Institute of Electrical Engineers—Winter general meeting, New York, N. Y., January 8-12.

Plant Maintenance & Engineering Show—Exhibits International Amphitheatre, Conferences Hotel Conrad Hilton, Chicago, Ill., January 25-28.

National Electrical Manufacturers Assn.—Edgewater Beach Hotel, Chicago, Ill., March 8-11.

National Association of Electrical Distributors—Annual convention, Atlantic City, N. J., Week of June 6.

"HERE'S MY PROBLEM" began Charlie Smith of the J. E. Berger Corp., Detroit, Mich. (right) when he ran into Ed Grant, Tennessee Electric Motor Service, Nashville, Tenn., at the 1953 national NISA meeting in New York.

DITCH WITCH World's Best SMALL TRENCHER
FAST! STURDY

4 DITCH-WITCH Models
Digs 2" to 6" Trenches
Any Depth to 36"

A self-contained ditcher operating under its own power—digs clean even 2" to 6" trenches to a 36" depth. Light weight, mobile, low operating and maintenance costs.

DITCH-WITCH used in these Industries: Construction, Maintenance, Petroleum, Railroad, Electrical, Plumbing, Municipal

PROVED IN ALL SOILS
DITCH-WITCH digs as many feet of trench as machines four times its size. Pays for itself in a few days.

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CLAMP and LOCK YOUR CONNECTIONS { THE K&H WAY

This
SWIVEL U-BOLT CONNECTOR
is designed to do just that...

No Removable Parts
Easily and Speedily Installed
Sturdily Constructed

MEET ALL REQUIREMENTS
85% Copper Alloy • Ample Strength
High Conductivity • Unaffected by Vibration
Moisture Resistant
Sizes Up to 1,000,000 CM.
Approved by Engineers

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Headquarters Announcements

Minneapolis-Honeywell Regulator Co., New York—Arnold Michelson, resident vice president.

Apex Electrical Mfg. Co., Cleveland, Ohio—Edwin A. Hamala, product sales manager, Vacuum Cleaner Div.; Stanley Silber, product sales manager, Dishwasher Div.

Minnesota Mining & Manufacturing Co., St. Paul, Minn.—Robert L. Westbee, vice president in charge of electrical products division.

Rodale Manufacturing Co., Inc., Emmaus, Pa.—Jack Kushner, assistant to the president.

Westinghouse Electric Corp., Pittsburgh, Pa.—Robert C. Cheek, assistant manager of engineering, Electronics Div.; Clarence M. Clark, manager, Electronic Tube Div.; A. Morton Cooper, manager of application engineering, Gearing Div.; George H. McBride, assistant division manager, Switchgear Div.

Howard Industries, Inc., Racine, Wis.—Harry D'Almaine, general sales manager.

Barry Corporation, Watertown, Mass.—A. S. Chivers, assistant sales manager.

Toledo Commutator Co., Owosso, Mich.—Walter C. Howe, president and treasurer; Elmer C. Haver, vice president and general manager; Elmer R. Bisard, secretary and assistant treasurer.

Kurman Electric Co., Inc., Long Island City, N. Y.—Ray S. Spiegelman, president; Julian Goodstein, vice president in charge of production; Nathan A. Kurman, vice president in charge of engineering.

Otis Elevator Co., New York—Morton B. Kahn, manager, Electronics Division.

Cold Cathode Lighting Corp., Long Island City, N. Y.—Walter S. Stanton, architectural representative.

Potter & Brumfield, Princeton, Ind.—G. W. Moler, general sales manager.

TelAutograph Corporation, New York—George M. Szabad, president.

United States Rubber Co., New York—James C. Westfall, assistant to the vice president and general manager, Mechanical Goods Div.

Line Material Co., Milwaukee, Wis.—Harold T. Zamzow, western apparatus manager; Nick K. Delaney, manager of capacitor and regulator sales; Carl E. Hoelz, manager of construction materials sales.

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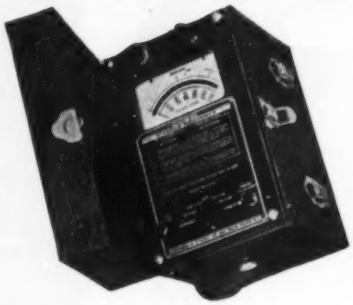

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General Electric Co., Schenectady, N.Y.—R. C. Hanna, manager, Marketing Dept.; Carl H. Rinne, general manager, Specialty Transformer Dept.; Charles P. Hayes, general manager, Ballast Dept.; Gilbert C. Ruckel, manager of marketing research and personnel development, Lighting and Rectifier Dept.; E. Norton Sampson, sales manager of rectifier components, Lighting and Rectifier Dept.

S&C Electric Company, Chicago, Ill.—E. J. Sroka, director of properties and personnel; A. B. Chilcoat, director of purchasing and production; C. C. Martin, manufacturing manager.

National Carbon Co., New York—J. R. Johnstone, manager, Carbon Products Sales Dept.

Boston Woven Hose and Rubber Co., Cambridge, Mass.—Thomas Hayes, light mechanical development manager.

Duro-Test Corp., North Bergen, N. J.—Herbert A. Anderson, commercial engineer.

Bakelite Company, New York—Albert E. Maibauer, manager, Wire and Cable Materials Div.

Allis Chalmers Mfg. Co., Milwaukee, Wis.—Clyde R. Braun, manager, nuclear power section.

Sylvania Electric Products, Inc., New York—Herman L. Schreiner, special sales representative for national accounts; John D. Colombo, national accounts special representative, Lighting Division.

Regional Appointments

NEW ENGLAND

Southern States Equipment Corp.: Frederic S. Bacon, representative for Maine, New Hampshire, Vermont, Massachusetts and Rhode Island.

Minneapolis-Honeywell Regulator Co.: Fred Kaiser, New York, N. Y., manager of the Eastern region.

MIDDLE ATLANTIC

Sylvania Electric Products, Inc.: Tom H. Cashin, Buffalo, N. Y., district sales manager for the Lighting Division in upper New York State, western Vermont and northern Penn.

Anaconda Wire & Cable Co. announces transfer of its Rochester, N. Y., office to the Kemper Building, Syracuse, N. Y.

BullDog Electric Products Co.: Milton C. Smith, representative in Buffalo, N. Y.

General Electric Company: George E. Shepherd, northern New Jersey sales representative for the Silicone Products Dept., Chemical Div.

SOUTH ATLANTIC

General Electric Company: R. H. Jackson, Atlanta, Ga., manager of

Searchlight Section

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sales for the Southeastern District of Apparatus Sales.

Potter & Brumfield: D. J. Fagge, manager of the Washington, D. C., sales office.

S & M Lamp Co.: Joe H. Akerman, Coral Gables, Fla., representative for the Flood-Lite Div. in Florida.

EAST CENTRAL

Allis-Chalmers Mfg. Co.: H. R. Wilson, manager of the Rockford, Ill., branch office.

Sterling Electric Motors, Inc.: Earl J. Phillips, district manager in the new Chicago, Ill., sales office.

Appleton Electric Company: E. A. Hakanson, manager of the Chicago, Ill., sales district.

Sterling Engineering Company: Sam S. Dewson, representative for the Chicago area and parts of Illinois, Indiana, Michigan and Wisconsin.

General Electric Company: W. A. Mosteller, manager of sales for the Apparatus Sales Div. in the Michigan District; F. T. Scott, manager of product sales, Michigan District; E. I. LeBaron, manager of the Flint, Mich., office of the Michigan District.

Graybar Electric Company: S. M. Cook, manager of the Milwaukee, Wis., branch office.

Line Material Company: Gordon J. Griffith, field engineer, Milwaukee, Wis., covering southern Wisconsin.

WEST CENTRAL

Blackhawk Mfg. Co.: Marvin J. Wells, territory manager in Oklahoma City, Oklahoma; Robert R. Westbrook, territory manager in Fort Worth, Texas; Norman Card, territory manager in Memphis, Tenn.

Sterling Engineering Co.: J. O. Schmitz, representative in Kansas City, covering Missouri, Kansas and Nebraska.

General Controls Co.: Allen S. Carpenter, manager of the Omaha, Nebraska, branch office.

Anaconda Wire & Cable Co.: Robert T. Shiels, Jr., district manager in the Dallas, Texas, territory.

WEST

Line Material Co.: Robert J. Norton, apparatus engineer, Denver, Colo., Mountain States Division; Harold T. Brazil, field engineer, Butte, Montana, Western Division; Earl M. Stites, San Francisco, Calif., field engineer, Western Division; Thomas J. Chapman, lighting engineer, Mountain States Division, Spokane, Wash.

Jersey Specialty Co.: James C. Trisoliere, representative, Sandy, Utah, covering Wyoming, New Mexico, Utah and Colorado.

Sylvania Electric Products, Inc.: Roger J. Delander, district sales manager, Seattle district, Seattle, Wash.

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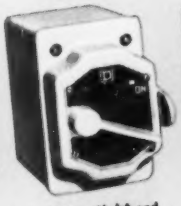

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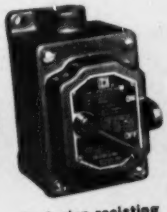

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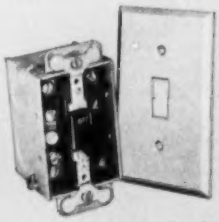

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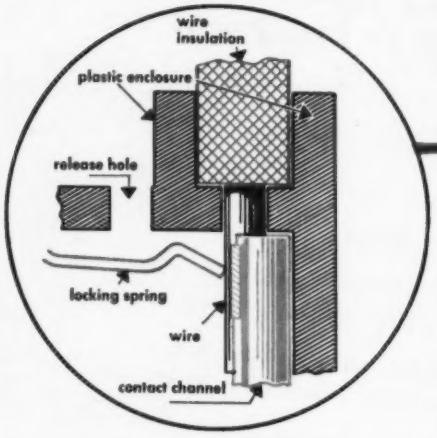

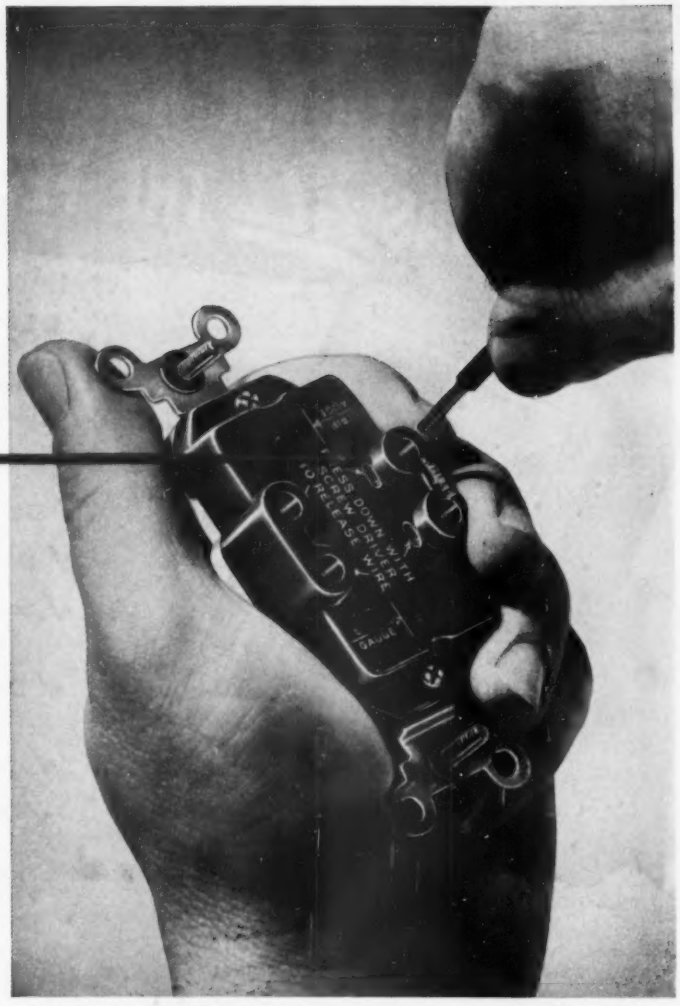

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